THE HUMAN FOOT

ANATOMY, DEFORMITIES AND TREATMENT

A VOLUME CONTAINING A COMPLETE AND COMPREHENSIVE DESCRIPTION OF THE ANATOMY OF THE FOOT. NORMAL AND ABNORMAL CONDITIONS, DEFORMITIES OF THE FOOT, THEIR CAUSE AND MECHANICAL TREATMENT. SPECIAL CHAPTERS ON SHOE FITTING AND ITS ALLIED BRANCHES, INCLUDING HISTORICAL FOOTWEAR.

A TEXT BOOK FOR THE STUDENT AND PRACTITIONER

BY

DR. WILLIAM M. SCHOLL

PUBLISHED BY THE

FOOT SPECIALIST PUBLISHING CO.

CHICAGO, U. S. A.

CONTENTS

PREFACE

IN presenting this volume, probably the first of its kind ever published, I do so only after numerous requests from the students and profession desiring to become more efficient in the care and covering of the human foot. Great care and every consideration have been taken, with a purpose to convey the fundamentals in a language thoroughly understood by the layman as well as the practitioner.

The anatomy of the foot, a knowledge of which I consider a valuable asset to those interested in these branches, is written in an elementary manner, and profuse with illustrations that it may be readily understood by all. I have embodied considerable information of the utmost value to the shoe man, chiropodist, orthopedist and the general practitioner of medicine.

Cognizant of the many discomforts, pains and improper shapes, fitting and styles of shoe, I feel assured that a work of this kind in the possession of the shoe man will render him more proficient in his calling.

To be familiar with the structure of the human foot and its deformities, with the serious consequences of the improper fitting of sizes and shapes of shoes, is a step toward the abolition of many foot ailments. Thus, a careful study of the subjects contained in this volume will enable the shoe fitter to not only apply correct remedial measure, but to remove the cause giving rise to these deformed conditions. The fitting of proper shoes and hosiery, and perhaps a modified simple appliance will render much foot comfort and shoe satisfaction. Considerable good can be accomplished by the profession in prescribing proper corrective appliances and foot gear.

In the preparation of this volume reference has been made to the works of Gray, Cunningham, Bradford, Lovett, Stimson and others for which acknowledgment is made.

Before concluding, I wish to state that the illustrations, etc., shown in this book are gathered from my experience in the mechanical treatment of weakened and deformed conditions of the foot, with that of my contemporary colleagues, extending over a period of fifteen years.

DR. WM. M. SCHOLL.

INTRODUCTION

IN the study of anatomy—the foundation of medical science—we shall confine ourselves more particularly to a general and detailed consideration of the study of the human foot. A volume might be written upon anatomy alone, but it is only necessary here to deal with those points absolutely essential to the student and also with the structures of the foot, viz: Bones, muscles, nerves, etc., and this course has been followed throughout.

The mechanical consideration of the foot, its abnormal condition, causes and mechanical treatment, will then be discussed. Believing that mechanical treatment affords the most satisfactory and gratifying results, I have included various chapters describing the same that the student may familiarize himself with the proper remedial appliances and their mode of application.

In my description of the deformed conditions of the foot I discuss the various joint diseases and deformities that the student may be better enabled to recognize those cases which require the attention of a skilled surgeon, and to advise the patient to this effect that the case may be correctly diagnosed and treated.

Before fitting a pair of arch supports it is advisable to determine if the deformity is not of systemic origin; if the latter the patient should be referred to a physician at once.

The shoe being an important adjunct of the foot and the prime causative agent of deformities it will be discussed at length, reverting to the origin of shoes and footwear and continuing with a chronological history of shoes worn to the present period.

Suggestions on shoe fitting, construction, last measurements and information in general pertaining to this subject will be discussed in the following chapters.

CHAPTER I

THE BONES

In order to thoroughly comprehend the bony structure of the foot, it is advisable to give a description of the framework of the body.

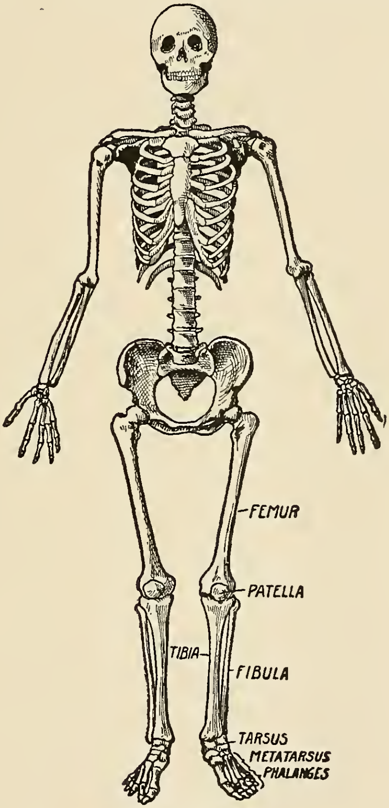


CHART No. A1
Skeleton of the Human Body.

Bone is one of the hardest structures of the body, consisting of a dense, compact texture, and is covered by a fibrous membrane called Periosteum from which the bone derives its nourishment.

Bones form the framework over which the structures are built and when covered with muscles and flesh make the contour perfect.

BONES OF THE HUMAN BODY

The human body has as its foundation a framework of approximately two hundred bones, and of this number there are twenty-six bones in each foot, and as this concerns the student most, the upper extremity will be entirely omitted. The bones of the lower extremities consist of the thigh, leg and foot.

The Pelvis is most massively constructed, a heavy, bony ring interposed between the end of the spine which it supports, and the lower extremities upon which it rests.

Next to the Pelvis comes the Thigh. The Thigh is that portion which is situated between the Pelvis (beginning at the hip) and the Knee. It consists in the skeleton of a single bone, the Femur (thighbone), which is the longest, strongest and largest bone in the skeleton.

The skeleton or bones of the leg consist of the Tibia and Fibula, and the Patella or Knee Cap. The Tibia is situated at the front and inner side of the leg and, excepting the Femur, is the largest and longest bone in the skeleton. It articulates with the knee-joint above and with the Astragalus or key-bone of the arch below.

The Fibula is situated at the outer side of the leg. It is the smaller of the two bones and, in proportion to its length, the most slender of all the long bones. The Fibula acts as a balance to the Tibia, and in case of fractures they are both usually broken. (See Chart No. 1.)

As the foot receives the entire weight of the body, is it not natural to assume that this part of the body is most likely to become distorted, as is the fact? For example, we will take a person weighing two hundred pounds. Just think of the pressure exerted upon the weak framework of the foot. In such individuals we find flat-foot to be a general affliction. That the various resulting deformities may be thoroughly understood, it is necessary to be familiar with the different bones which make up the framework of a foot. Thus, referring you to Chart No. 3, I have divided the foot into three principal parts for the convenience of the student.

1. Phalanges or Toes.
2. The Metatarsus.
3. Tarsus or Heel and Ankle Joint.

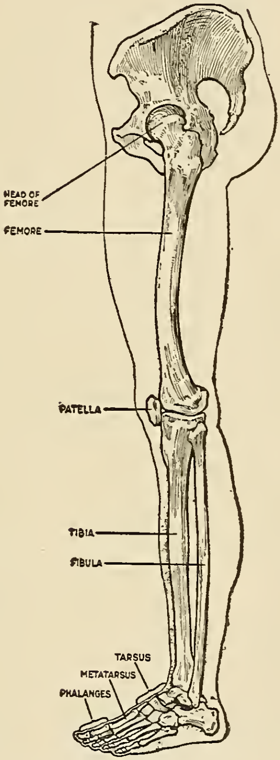


CHART No. 1
Bones of Leg and Foot.

Now let us take up each one separately. You will notice by Chart No. 2 that each toe has three bones, called Phalanges, except the large toe, that only having two bones. The Metatarsus has five bones, called Metatarsal bones. Notice that the Metatarsus has as many bones as there are toes on a foot, and each corresponds to the

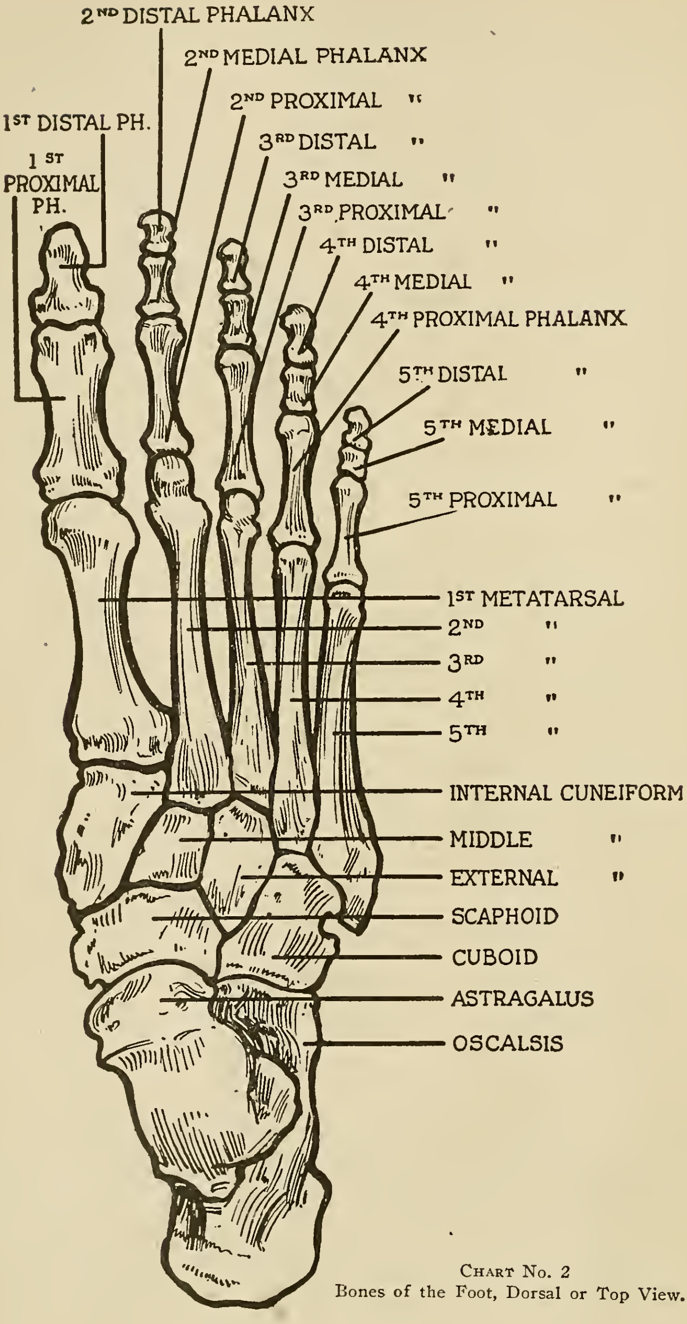


CHART No. 2
Bones of the Foot, Dorsal or Top View.

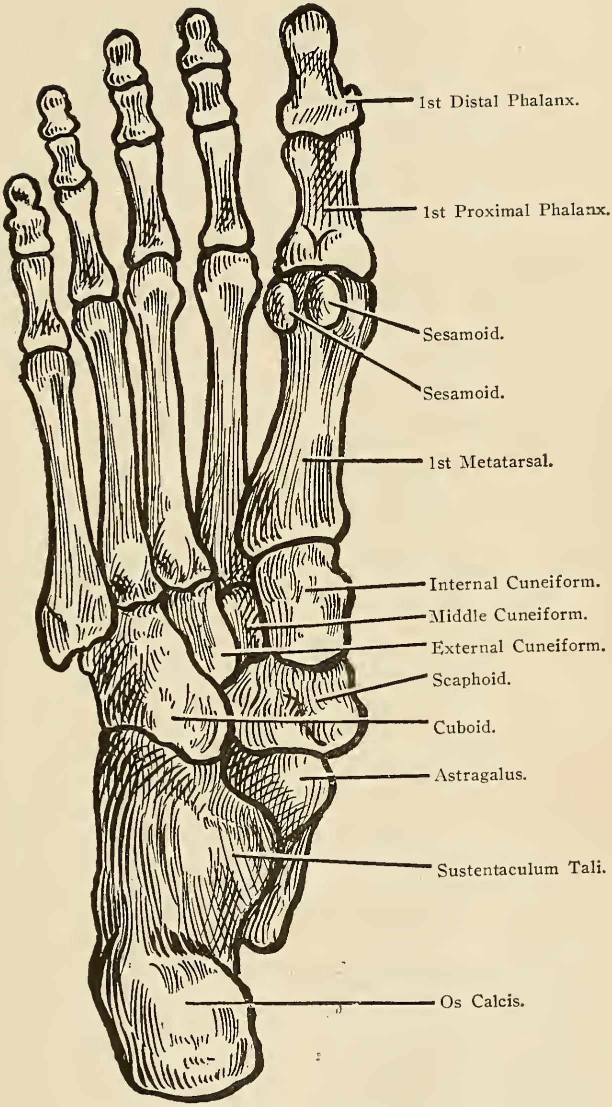


CHART No. A3.
Bones of the Foot, Plantar or Bottom View.

respective toe. Next is the Tarsus, which also includes the Ankle Joint. This has seven bones, as follows:

Three Cuneiform, Scaphoid, Cuboid, Astragalus and Os Calcis.

It is a very easy matter to remember the number of bones in the foot. If you will remember, each toe has three bones, except the large toe, it having one less. Everybody knows there are five toes on every foot, so consequently there are fourteen bones in the five toes on each foot. The Metatarsus has one bone for each toe, consequently the Metatarsus contains five bones, making nineteen bones for toes and Metatarsus together. Now, if there are twenty-six bones in all

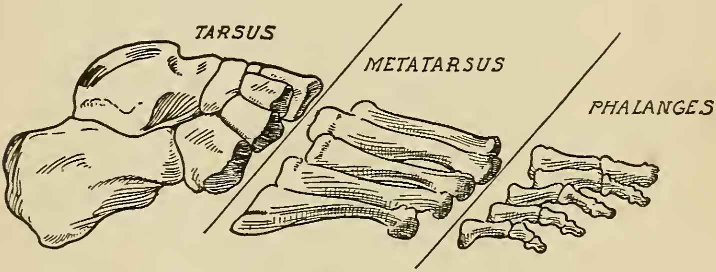


Chart No. 3
Dividing the Foot into the Three Groups of Bones.

in the foot, there remain but seven bones for the Heel and Ankle Joint. Again, each bone forms a joint with the succeeding bone, so in the toes we have several joints. Any one of these bones may be distorted, forming a malformation of the foot. The bones of the Arch and Ankle have several joints which may in turn be distorted and produce a malformation.

It is very plain from the foregoing that the knowledge of the different bones of the foot is of the utmost importance to a foot specialist. Let us now continue to explain the relation of the muscles, ligaments, arteries and nerves of the foot to the bones before we take up the study of each individual bone. Each bone in the foot is supplied with arteries, nerves and a number of muscles and ligaments. Later on we shall consider the minute details of every artery, nerve, muscle and ligament, but at this moment it will serve our purpose to refer to the same in a general way.

Take, for instance, the muscles and ligaments which are attached to the toes and arch of the foot, which are constantly stretched when a person walks. Should the pressure be too great, these muscles and ligaments become weakened, and the bones of the foot do not have their support, the result being a displacement of that bone whose muscles and ligaments have been weakened. Let us now consider why these conditions would be painful.

The distorted bone or malformation may press against a nerve, producing pain, or it may press against an artery, which would interfere with the natural circulation of the blood supply in the foot. Before continuing with the next chapter, I recommend the re-reading of Chapter I, as it should be thoroughly comprehended in order to master the description of each bone of the foot.

CHAPTER II

THE TARSUS

Referring you again to Chart No. 2, you will find each bone of the foot represented by its respective name. In the previous chapter I called your attention to the fact that the foot had twenty-six bones and that the heel and ankle joint contained seven bones. I will here describe each bone separately.

For our convenience we will commence with the heel. I now refer you to Chart No. 3, where you will again find the foot divided into three different parts, but each part is named respectively:

The Tarsus, which is the back part of the foot, includes the heel and ankle joint.

The Metatarsus or the middle part of the foot has the appearance of an arched bridge.

The Phalanges or the front part of the foot includes all the bones of the toe.

1. **The Os Calcis or Heel Bone** is the largest and strongest bone of the foot, and is situated at the back of the foot in front of which are the Astragalus and Cuboid bones. Referring to Chart No. 3 you will see that this bone forms the heel and is irregular and cuboidal in shape. The chief facts about this bone to be remembered are that it transmits the weight of the body to the ground and that it articulates with the next two bones, the Astragalus and Cuboid. It is held in its position by strong ligaments. The muscles of the calf of the leg and Achillis tendon are also attached to this bone. The importance of this bone is readily observed in deformities of the foot.

2. **The Astragalus Bone.**—As you will notice in Chart No. 2, the next bone to the Os Calcis is the Astragalus. It is also the next largest bone of the Tarsus, and is situated in front of the Os Calcis and is the middle bone of the Tarsus, being supported underneath

by a part of the Os Calcis and articulates in front with the Scaphoid bone. The upper surface of the Astragalus is so shaped as to receive the bone of the leg.

This bone is called the Tibia, and as the weight of the entire body is transmitted through the leg and is received at the upper part of the Astragalus, it can be clearly understood that this bone is the *most* important one of the lower appendages, and liable to succumb under the great weight borne, producing the deformity known as flat-foot. This bone has strong ligament and muscle attachments, which are frequently stretched by the constant strain placed upon them, causing the Astragalus to be displaced.

3. **The Scaphoid Bone.**—This is the bone which I described as being immediately in front of the Astragalus.

On the chart you will readily notice that this bone is situated on the inner side of the Tarsus, and articulates with the Astragalus behind and with the three Cuneiform bones in front. From its position in the Tarsus, it is evident that the Scaphoid bone also plays an important part in flat-foot cases, as it is also in the center of the foot and can be readily felt in such deformities.

4. **The Cuboid Bone.**—This is the bone which is situated on the outer side of the Tarsus, immediately in front of that part of the Os Calcis which does not articulate with the Astragalus. You will notice by the chart that the Cuboid bone fills up that space between the outer side of the Os Calcis and the fourth and fifth Metatarsal bones. The Cuboid also articulates with the External Cuneiform bone. There is no doubt that this bone is usually involved in conditions of flat-foot.

5. **Internal Cuneiform Bone.**—There are three Cuneiform bones, namely, the Internal, Middle and External. They are thus named according to their location, as, for instance, the Internal Cuneiform which we are about to describe is situated on the internal surface of the Tarsus. It is located immediately in front of the Scaphoid bone and articulates with the Scaphoid behind, the first Metatarsal bone in front, and on the side with the Middle Cuneiform and part of the second Metatarsal bone. The relation of this bone shows

plainly that it is very often distorted as are the other bones of the Tarsus.

6. **Middle Cuneiform Bone.**—This bone is so named because it is situated between the Internal and External Cuneiform bones.

It is the smallest of the three Cuneiform bones and articulates with the Scaphoid behind and the second Metatarsal bone in front, with the Internal Cuneiform on the inner side and the External Cuneiform on the outer side. The relative position of this bone is identical with that of the other Cuneiform bones, which are invariably affected by any displacement of the bones of the Tarsus.

7. **External Cuneiform Bone.**—This is the last bone of the Tarsus to be described. It is situated in the middle of the foot, and for this reason receives a considerable degree of pressure. It articulates with the Scaphoid behind, the third Metatarsal bone in front and the Cuboid and part of the fourth Metatarsal bone on the outer side, and also with the middle Cuneiform on the inner side.

We have now considered all seven bones of the Tarsus; thus you will notice that the last six bones go to make up part of the arch of the foot which is so important in flat-foot subjects. In the next chapter we will describe the five Metatarsal bones which make up the other part of the arch.

CHAPTER III

THE METATARSUS AND THE PHALANGES

THE METATARSUS

The Metatarsus consists of the five Metatarsal bones, numbered one to five, number one commencing at the great toe.

1. **First Metatarsal Bone.**—This is the shortest but thickest bone of the Metatarsals. It articulates with the Internal Cuneiform bone behind and with the first Phalanx of the large toe in front.

2. **Second Metatarsal Bone.**—This is the longest of the Metatarsal bones. It is situated between the first and third Metatarsal bones and articulates with the Middle Cuneiform bone and part of the Internal and External Cuneiform bones behind and laterally with the third Metatarsal bone.

3. **Third Metatarsal Bone.**—There is nothing particular to remember about this bone, except that it articulates with the External Cuneiform bone behind and laterally with the second Metatarsal bone on the inner side and the fourth Metatarsal bone on the external side.

4. **Fourth Metatarsal Bone.**—In describing this bone all one has to remember is that it articulates with the Cuboid bone and External Cuneiform bone behind, the third Metatarsal bone internally and the fifth Metatarsal bone externally.

5. **Fifth Metatarsal Bone.**—It is the smallest of the Metatarsal bones and is situated on the outer side of the foot. It articulates with the Cuboid behind and laterally with the fourth Metatarsal bone.

This concludes the description of all the bones of the arch of the foot. In the previous chapters I called your attention to the fact that all these bones had muscles and ligaments attached to them. They play an important part in malformations of the foot, and you must always bear in mind, when we find a malformation, that these muscles and ligaments are generally affected.

THE PHALANGES OR BONES OF THE TOES

Each toe, as you remember, has three Phalanges, except the large toe, which has only two.

The Phalanges which articulate with their respective Metatarsal bones are called the first Phalanx of each toe, consequently the next Phalanx in each toe is called the second or Medial Phalanx, and the last Phalanx is called the third or Distal Phalanx. Of course there is not a third Phalanx in the large toe, as that toe only has two Phalanges. In order to understand with what bones they articulate I refer you to Chart No. 2, and there you will notice that the first Phalanges articulate with their respective Metatarsal bones behind and with the second Phalanx of each toe in front.

The second Phalanx in each toe articulates with the first Phalanx behind and the third Phalanx in front. Again the exception is the large toe, as previously stated; it has only two Phalanges.

That leaves the four Distal or third Phalanges to be described. They articulate with the second Phalanx of each toe behind and are flattened in front so as to receive the nail of the toes.

The Phalanges play an important part in malformation of the feet as they are often distorted, due to ill-fitting shoes, such as high heels and narrow-pointed lasts. Very often one toe overlaps the other. We also find many ingrown toe nails, etc.

These conditions will all be described as we advance. Before we proceed I must call your attention to two other bones, namely, those two bones which are in the lower limb, for they are the bones which are received by the Astragalus and are part of the ankle joint. The large shin bone is called the Tibia; the smaller bone, which is located on the outer side of the large bone, is called the Fibula. I believe a description of these bones would enable you to more thoroughly understand the ankle joint.

THE TIBIA

Is the largest of the two bones in the lower part of the leg. It is situated in front and the inner side of the leg, and is otherwise called the shin bone. The upper part of the bone is called the head of the Tibia. It is very much enlarged at the head and articulates with the Femur (which is the thigh bone) to form the knee joint. It then tapers gradually until it reaches the lower part of the bone, that part between the head of the Tibia and lower extremity being called

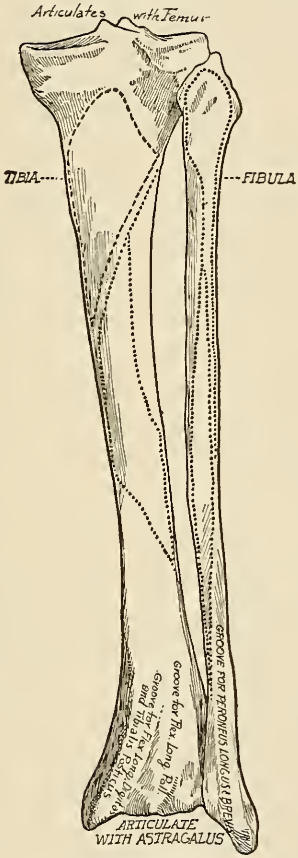


CHART No. 7
Bones of the Right Leg
Posterior Surface.

the shaft of the bone. The lower extremity is smaller than the upper one and it articulates with the Astragalus. You can readily see the importance of this bone in considering the ankle joint. The lower part of the bone internally forms the Internal Malleolus. The Malleolus is that part of the ankle joint which is most prominent on the internal side of the ankle. Many muscles are attached to this bone, which also are attached to the bones of the foot. The outer side of the head of the Tibia articulates with the Fibula, which is the second bone of the lower leg. The outer side of the lower extremity of the Tibia also articulates with the Fibula. I refer you to Chart No. 7, which will explain fully the relation of these bones to each other.

THE FIBULA

The small bone of the lower part of the leg is situated on the outer side of the Tibia which we have just described. It is much thinner and articulates above with the outer side of the Tibia, running parallel with the same, and being situated directly in back of it at the lower extremity, it inclines a little forward and projects a little below the Tibia, forming the outer prominence of the ankle joint or External Malleolus. This bone as well as the preceding one has many muscles and ligaments attached to it, which also are attached to the bones of the foot. The function of this bone is to act as a balance to the Tibia in transmitting the weight into the foot. It is important for the student to master each bone of the foot and leg thoroughly, making it unnecessary to consult the charts every time you read about them. For this reason I emphasize the necessity of studying the different charts and the description of each bone.

In the next chapter we will consider the arches of the foot. As you have made yourself familiar with the names of the bones and have a mind picture of their shapes and sizes, it will not be difficult for you to now thoroughly understand the anatomical descriptions. The arches are very important in foot trouble cases.

CHAPTER IV

ARCHES OF THE FOOT

The bones of the foot are arranged to adapt themselves best for their work, and are so joined to form two distinct arches—the Longitudinal Arch and the Transverse Arch.

Some writers mention that there are three by taking in the Outer Longitudinal Arch, and others say there are four by taking the Transverse Arch and the Anterior Metatarsal Arch as separate arches, but we will describe the Longitudinal Arches, both inner and outer, and the Anterior Transverse Arch. (See Chart No. 4.)

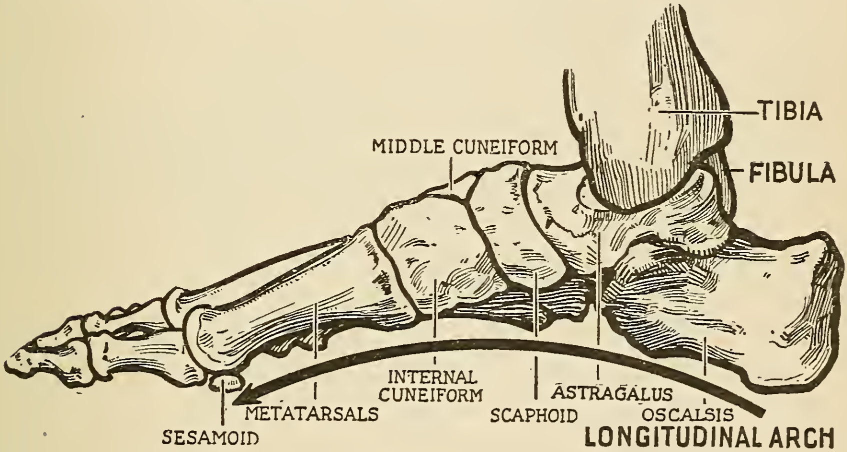


Chart No. 4
Bones of Foot Showing Inner Longitudinal Arch.

INNER LONGITUDINAL ARCH

The inner Longitudinal Arch carries most of the weight. It is composed of the Os Calcis from behind as furnishing the main support and the head of the first Metatarsal furnishing the forward support. It extends from the inner side of the Os Calcis and is composed of the Os Calcis, the Astragalus, the Scaphoid, the Internal Cuneiform and the first Metatarsal.

OUTER LONGITUDINAL ARCH

The outer Longitudinal Arch extends from the outer side of the bottom of the Os Calcis to the head of the fifth Metatarsal, and is composed of the Os Calcis, Cuboid and fifth Metatarsal, this being the shorter arch and not frequently disturbed in ordinary cases. The two arches to bear in mind are the inner Longitudinal Arch and the Anterior or Transverse Arch. (See Chart No. 5.)

These arches are supported mainly by ligaments, and the Longitudinal Arch is weakest between the Astragalus and the Cuneiform where it is very liable to yield, giving cause to flat-foot.

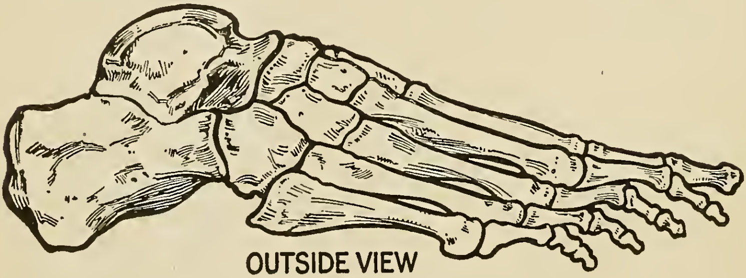


Chart No. 5
Showing Outer Longitudinal Arch.

THE TRANSVERSE OR ANTERIOR ARCH

This arch extends across the ball of the foot from the outside of the head of the first Metatarsal to the outside of the fifth Metatarsal. It is composed of the second, third and fourth Metatarsal in addition to the first and fifth.

This arch plays an important part in the mechanics of the foot, as it provides for the elasticity as well as the strength of the foot and permits of space for the muscles, nerves and blood vessels of the sole of the foot to protect them from pressure. The Metatarsal heads which go to make up the Anterior Transverse Arch are very frequently subjected to displacement, creating much disturbance to the foot. (See Chart No. A6.)

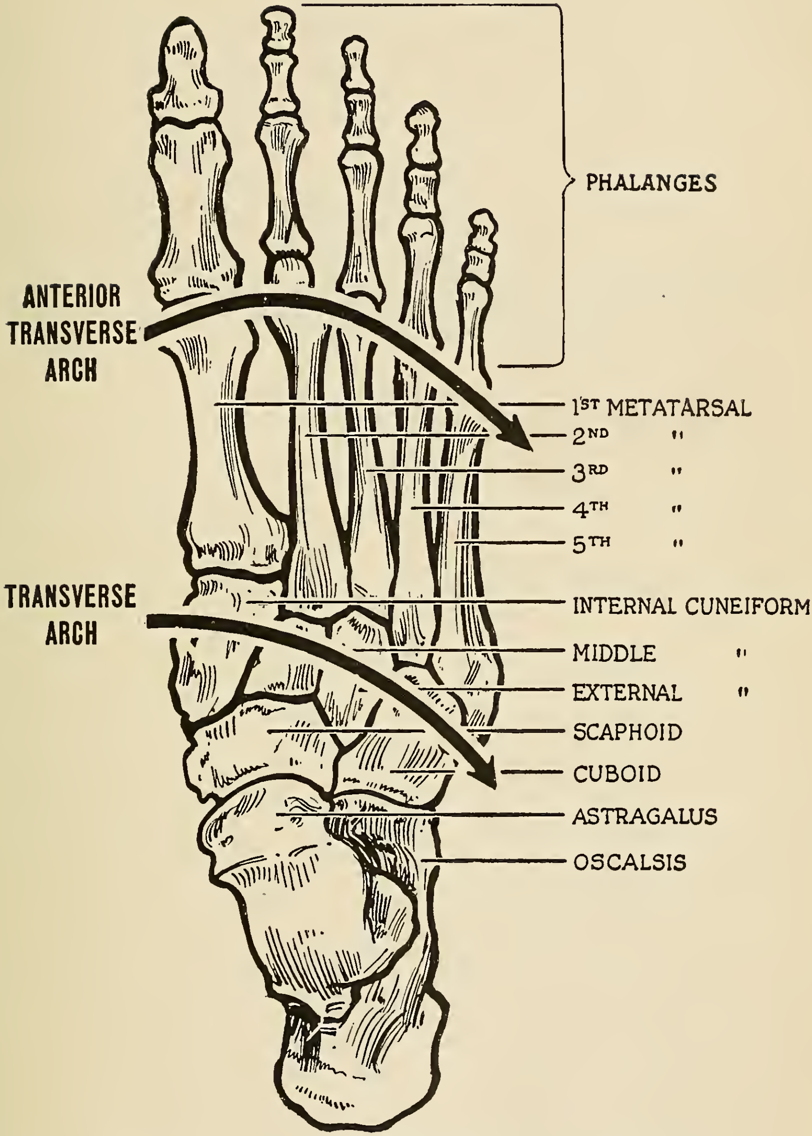


CHART No. 6
Showing Transverse and Anterior Transverse (or Metatarsal) Arch.

We have considered the entire bony structure of the foot and ankle joint, and it would now be advisable to explain to you in a general way, first, what keeps these bones in their respective posi-

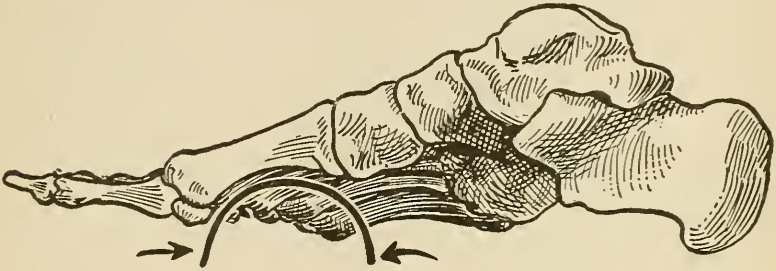


CHART No. A6
Arrows Point to Line of Dome Forming the Transverse Arch.

tions. The best way to understand this is by considering each structure, such as ligaments, muscles, tendons, arteries, veins and nerves separately, then later describe their location, etc.

CHAPTER V

SOFT STRUCTURES OF THE FOOT

In order that we may clearly understand each one of these various structures, we must know of what they consist and their action. Thus, let us study that first.

LIGAMENTS

Each bone of the skeleton joins another bone, this producing a joint of the two respective bones, which are held together by ligaments consisting of tough fibrous bands of tissues. We can thus define a ligament as follows: A strong fibrous band of tissue, whose function is to hold the bony joints in their respective places; composed of waving bands of white fibrous tissue held together by a semi-fluid substance, pliant and flexible, to allow freedom of movement but inextensible so as not to readily yield under pressure. In ligaments and tendons these bundles run parellel with each other. They are exceedingly strong so that upon the application of external violence the bone with which it is connected will fracture before the fibrous tissue would be ruptured. Continuous strain may cause ligaments to lose their normal tone and toughness. Whereas the tendons are composed of the same tissue as ligaments, we will consider them next.

TENDONS

Tendons are white fibrous cords varying in length and thickness. Sometimes they have a round, sometimes a flattened appearance; very strong in texture, but having no elasticity. These fibers run parallel with each other as in the ligaments, and are composed of the same kind of fibrous tissue. The tendons serve to connect the muscles to the bony structures, and in many instances appear almost like a continuation of a muscle. You will notice I am taking the structures of the foot from the innermost part, outward. First we considered the bony structure in full; then I gave you a description of the ligaments which are the structures next to the bones and serve to hold them in their respective positions. Then the tendons, which form the link between the muscles and the bones and serve as levers, and transmit the action from the muscles to the different bones when movement of a joint is required.

MUSCLES

Now we are to consider the muscle tissue and its function in general. Muscles are defined as follows: A muscle is a bundle of fibers intermingled with arteries, veins and nerves varying in the arrangement according to their attachment as, for instance, where muscles are attached to bony structure they terminate in blunt extremities upon the covering of the bone. Should they be attached to tendons their fibers gradually taper into a small bundle of fibers and are connected with fibrous tissue to the tendons.

We have different shapes of muscles such as long, broad, short, etc. These terms will be used later when we describe each individual muscle. For instance, we find long muscles in the leg and short muscles in the foot.

The upper part of a muscle is generally termed the origin of a muscle, the middle part the belly and the lower the extremity or insertion end of the muscle. I could expatiate upon the above description of ligaments, tendons and muscles, but I believe the foregoing will suffice to give you a general idea of these structures. Next in order come the arteries, veins and nerves. The arteries are very important structures, as they convey the blood which nourishes the different tissues of the body to all parts of the human anatomy.

ARTERIES

They are cylindrical tubular vessels which are made up of three coats of tissues. The inner coat consists of a layer of cells called epithelium, the middle coat consists of elastic and muscular fibers of tissue arranged in a circular manner, and the external or third coat mostly of elastic and connective tissues.

Let me call your attention to the circulation of the blood in those arteries, etc. The blood is expelled from the heart through the large arteries of the body. These large arteries branch off into smaller arteries called branches, and they again are subdivided into smaller vessels called capillaries.

You may liken the arterial system to a tree. The tree has branches and these branches again give off smaller branches. So we find that the blood is distributed all over the body through these different arteries, branches and capillaries. Again the blood is returned to the heart through a system of veins which we are about to consider.

VEINS

The veins, like the arteries, are composed of three coats, namely, the internal, middle and external coat. These coats are, with the necessary modifications, analogous to the coats of the arteries, the internal being made up of an epithelial layer of cells, the middle of muscular fibers, and the external of connective tissue. The main difference you will notice between the coats of the arteries and those of the veins is in the middle coat, which in the veins is composed of muscular tissue only, consequently making it a much stronger structure. Most of the veins are provided with valves which serve to prevent the reflux of the blood. These valves are formed by reduplications of the inner coats of the veins strengthened by connective tissue and elastic fibers, and are semilunar in form.

There remain only the nerves to be described in a general way, and then we have considered all the soft tissues which we find in the study of the leg and foot, and that which pertains to their general characteristics.

NERVES

Under this heading I could include the minute description of every nerve tissue in the body, but as it would burden you with unnecessary material requiring considerable time and study I have decided to discuss only that which would be of value in your work. You may liken the nervous system to the telephone system.

In the latter we have a central office from which wires radiate in all directions and messages are received from the outside to the central station. So we have the same conditions existing in the nervous system, namely, the brain of a person is called the central nervous system, and from this center the spinal nerves and other branches originate, consequently any stimulus from without or within would send a message to the brain or central nervous system to act. For instance, when a person sees something falling and wishes to pick it up, the central nerves send messages to the nerves in the muscles of the arm to act, I believe this a comprehensive illustration. We will now continue with a description of the tissues which make up a nerve.

Nerve tissue is composed of two substances, namely, gray matter and white or fibrous matter. The gray matter is mostly found in the brain, spinal cord and some of the nerves of special sense, which is intermingled with a fibrous nervous substance. We then must consider the nerves, as they are really what we have to deal with. We find nerve cells called neurons distributed throughout the nervous system; then we have nerve fibers, some being enclosed in a sheath while others are not. They generally run in bundles from the different nerve centers enclosed in a sheath to all parts of the body, as I explained above. So we find branches of nerves in all parts of the body, the foot also having its share. Should there be any displacement of bones they in turn would press on a nerve filament and produce excruciating pain. This concludes the description of the soft parts of the foot in a general way. We will now consider each ligament, tendon, muscle, artery, vein and nerve separately.

CHAPTER VI

THE LIGAMENTS

Under this heading we are obliged to consider all ligaments which may have all or partial influence on the movements of the ankle joint and foot, and for this reason it is best to start with those ligaments that connect the two bones in the lower limb, namely, the Tibia and Fibula.

TIBIO-FIBULAR LIGAMENTS

The Fibula is connected with the Tibia by an interosseous membrane in the middle, and at the upper and lower ends by ligaments.

The ligaments of these two bones are divided into three sets.

1. The Superior or Upper Tibio-Fibular ligaments.
2. The Middle Tibio-Fibular or Interosseous membrane.
3. The Inferior Tibio-Fibular ligaments.

1. **The Superior or Upper Ligaments** are two in number, called the Anterior and Posterior Tibio-Fibular ligaments.

2. **The Middle Tibio-Fibular Ligament** is a membrane extending from the margin of the Fibula and Tibia. It is continuous below with the Inferior Interosseous ligament.

3. **The Inferior Tibio-Fibular Ligaments** are of more importance for our study than the foregoing two sets of ligaments, as the inferior are directly connected with the ankle joint, and for this reason will give a more elaborate description of these.

THE INFERIOR TIBIO-FIBULAR LIGAMENTS

Are four in number, namely:

1. Anterior Inferior Tibio-Fibular.
2. Posterior Inferior Tibio-Fibular.
3. Transverse.
4. Inferior Interosseous.

Referring to Chart No. 8 you will notice their relations to the bones.

1. **The Anterior Inferior Tibio-Fibular Ligament** is a flat triangular band of fibers broader below than above and is situated in front between the Fibula and Tibia, extending from the margin of one bone to the margin of the other, at the lower end of the bones just above the ankle joint and comes in contact with the Astragalus

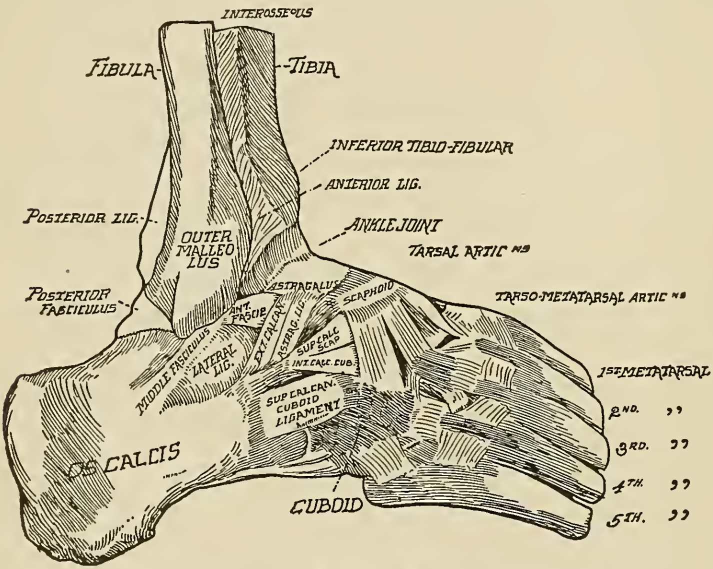


Chart No. 8
Ligaments of Ankle Joint.
(Right Foot, Outside View)

2. **The Posterior Inferior Tibio-Fibular Ligament** is of the same kind of tissue, but is smaller than the anterior; in fact the description of the posterior is the same except that this ligament is located posteriorly at the same position as is the anterior ligament. (See Chart No. 8.)

3. **The Transverse Ligament** is a long, narrow band continuous with the posterior ligament passing transversely across the back of the joint from the external Malleolus to almost the internal Malleolus, and

projects a little below the joint to form part of the articulating surface of the Astragalus.

4. **The Inferior Interosseous Ligament** consists of numerous short, strong fibrous bands which pass between the contiguous rough surfaces of the Tibia and Fibula and constitute the chief bond of union between the two bones. It is difficult to show these bands on a chart, but I feel certain from the description you can readily understand their location and action. (See Chart No. 8.)

LIGAMENTS OF THE ANKLE JOINT

Next we are to consider the ligaments of the ankle joint. They are four in number, namely:

1. Anterior.
2. Posterior.
3. Internal Lateral.
4. External Lateral.

1. **The Anterior, or Otherwise Called Anterior Tibio-Tarsal Ligament,** with reference to its location, is a broad, thin membranous layer attached above to the anterior margin of the articular surface of the Tibia and below to the margin of the Astragalus. (See Chart No. 9.)

2. **The Posterior, or Otherwise Called Posterior Tibio-Tarsal Ligament,** is also very thin and is attached to the posterior margin of the Tibia and posterior margin of Astragalus. (See Chart No. 8.)

3. **The Internal Lateral Ligament, or Otherwise Called Deltoid Ligament,** consists of two layers of fibers, namely, the superficial and deep layers. The *superficial layer* is a strong, flat triangular band attached above to the anterior and posterior borders of the Internal Malleolus. You will notice by referring to Chart No. 9 that the anterior fibers pass forward to be inserted into the Scaphoid and Inferior Calcaneo-Scaphoid ligament, the middle fibers descend perpendicularly to be inserted into the Os Calcis, the posterior fibers pass backward and outward, to be attached to the inner side of the Astragalus.

The *deep layer* is a short, thick and strong bundle of fibers and passes from the Malleolus to the inner surface of the Astragalus.

4. **The External Lateral Ligament** consists of three bundles of fibers, taking different directions, and are distinctly separated. They are named after their location, namely, the Anterior Fasciculus, the Posterior and Middle Fasciculus. A Fasciculus is a bundle of fibers drawn together.

a. **The Anterior Fasciculus** is the shortest of the three and passes from the anterior margin of the External Malleolus downward and forward to the front of the Astragalus.

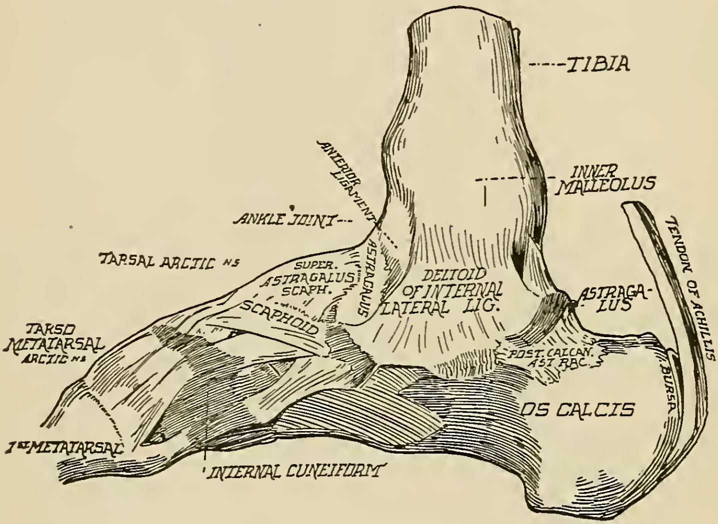


Chart No. 9
Ligaments of Ankle Joint.
(Right Foot, Inside View)

b. **The Posterior Fasciculus** is the most deeply seated and passes from the posterior surface of the External Malleolus to the posterior surface of the Astragalus.

c. **The Middle Fasciculus** is the longest of the three and appears like a narrow rounded cord passing from the External Malleolus downward and backward to the middle of the outer side of the Os Calcis.

(The above is very well illustrated in Chart No. 8.)

Referring back to the ligaments of the ankle which we just described, it is at once evident that the Internal Lateral or Deltoid ligament is of very great power, and that the Middle Fasciculus of the External Lateral ligament binds the bones of the leg firmly to the foot and resists displacement in every direction. The remaining ligaments of the ankle also resist displacement of the bones, and are attached to them, but not to so great a degree.

THE LIGAMENTS OF THE TARSUS

In order that you may understand the arrangement of this group of ligaments, it is necessary that we refer back to the bones of the Tarsus. (See Chart No. 3.) The bones are arranged in almost two separate rows. In the first row we will consider the Os Calcis and the Astragalus, and in the second row the Scaphoid, Cuboid and three Cuneiform bones. Therefore, in studying the ligaments which connect these bones, we will for simplicity divide them also into two respective rows, with an additional row which connects the Os Calcis to the Cuboid and the Scaphoid bones separately. The first row has three ligaments, namely:

1. External Calcaneo-Astragaloid.
2. Posterior Calcaneo-Astragaloid.
3. Interosseous.

1. **The External Calcaneo-Astragaloid Ligament** is a short, strong Fasciculus passing from the outer side of the Astragalus to the outer surface of the Os Calcis. (See Chart No. 8.)

2. **The Posterior Calcaneo-Astragaloid Ligament,** as its name implies, is situated between the two bones. (See Chart No. 9.) It is the chief bond of union between the Astragalus and Os Calcis and unites these bones firmly together. The second row has three ligaments, namely:

1. Dorsal (or top part of the foot).
2. Plantar (or sole of foot).
3. Interosseous.

1. **The Dorsal Ligaments** are so called because they are located on the Dorsal surface of the foot. They are small bands of parallel

fibers, which pass from each bone of the Tarsus to the neighboring bone with which it articulates.

2. **The Plantar Ligaments** have the same arrangements as the Dorsal ligaments, only they are situated on the Plantar surface of the foot.

3. **The Interosseous Ligaments** of the Tarsus are four in number, one between the sides of the Scaphoid and Cuboid, a second between the Internal and Middle Cuneiform bones, a third between the Middle and External Cuneiform bones, and a fourth between the External

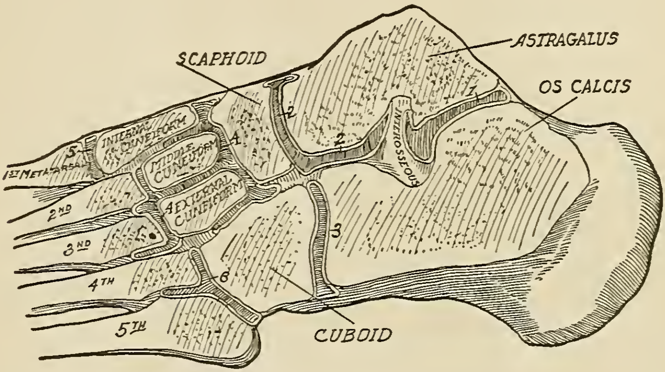


CHART NO. 10
Cut Section of the Bones of the Foot Showing Interosseous Ligaments.

Cuneiform and Cuboid bones. The third row has six ligaments, four ligaments connecting the Os Calcis and Cuboid together, and two ligaments connecting the Os Calcis and Scaphoid, namely:

1. Superior Calcaneo-Cuboid (on Dorsal Surface).
2. Internal Calcaneo-Cuboid (on Dorsal Surface).
3. Long Calcaneo-Cuboid (on Plantar Surface).
4. Short Calcaneo Cuboid (on Plantar Surface).
5. Superior Calcaneo-Scaphoid.
6. Inferior Calcaneo-Scaphoid.

1. **The Superior Calcaneo-Cuboid Ligament,** as the name implies, is a thin Fasciculus passing between the contiguous surfaces of the

Os Calcis and Cuboid bone on the Dorsal surface of the foot. (See Chart No. 8.)

2. **The Internal Calcaneo-Cuboid Ligament** is a short, thick and strong band of fibers and forms one of the chief bonds of union between

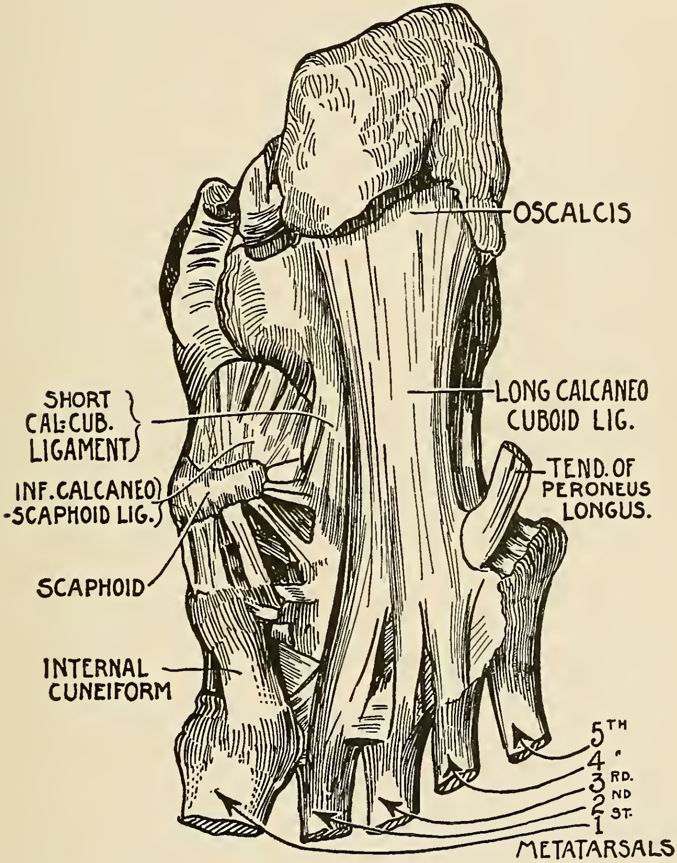


Chart No. 11
Ligaments of the Sole of Right Foot.

the first and second rows of the Tarsus. It is situated between the Os Calcis and the Cuboid internally. (See Chart No. 8.)

3. **The Long Calcaneo-Cuboid Ligament** is the longest of all ligaments in the Tarsus and is very superficial. (See Chart No. 11.)

It is attached to the under surface of the Os Calcis and its fibers pass forward to be attached to the under surface of the Cuboid bone, and some fibers to the second, third and fourth Metatarsal bones. This ligament is also called the long Plantar ligament.

4. **The Short Calcaneo-Cuboid Ligament** is short, being only one inch long, and very broad. It connects the fore part of the under surface of the Os Calcis to the inferior surface of the Cuboid bone. This ligament is also known as the short Plantar ligament. (See Chart No. 11.)

5. **The Superior Calcaneo-Scaphoid Ligament** passes forward from the inner side of the anterior extremity of the Os Calcis to the outer side of the Scaphoid bone. (See Chart No. 8.) It is located on the Dorsal surface of the foot.

6. **The Inferior Calcaneo-Scaphoid Ligament** is situated on the Plantar surface of the foot. (See Chart No. 11.) It is larger and stronger than the foregoing ligaments, and passes from the interior and inner extremity of the Os Calcis to the under surface of the Scaphoid bone. This concludes the ligaments of the Tarsus proper, and next in order are the ligaments which connect the Tarsal bones with the Metatarsal bones, called Tarso-Metatarsal ligaments.

TARSO-METATARSAL LIGAMENTS

There are three in number, namely:

1. Dorsal.
2. Plantar.
3. Interosseous.

1. **The Dorsal Ligaments** consist of flat fibrous bands which connect the Tarsal with the Metatarsal bones, and are situated on the Dorsal surface of the foot. The first Metatarsal bone is connected to the Internal Cuneiform by a single broad, thin fibrous band; the second Metatarsal bone has three Dorsal ligaments, one from each Cuneiform; the third Metatarsal has one from the external Cuneiform; and the fourth and fifth Metatarsal bones have one each from the Cuboid bone.

2. **The Plantar Ligaments** consist of longitudinal and oblique bands connecting the Tarsal with the Metatarsal bones on the Plantar surface of the foot. The first and second Metatarsals are more prominent, the second and third Metatarsals have strong fibers passing over the Internal Cuneiform, and the fourth and fifth Metatarsal bones have only a few fibers.

3. **The Interosseous Ligaments** are three in number, namely, the Internal, Middle and External. The internal one passes from the outer extremity of the Internal Cuneiform to the second Metatarsal. The middle one connects the External Cuneiform with the second Metatarsal. The external one connects the External Cuneiform with the third Metatarsal bone. Besides the above ligaments of the Tarso-Metatarsal articulations, there are Dorsal, Plantar and Interosseous ligaments of the Metatarsal bones proper. The Dorsal and Plantar ligaments pass from one Metatarsal bone to the other. (See Chart No. 8.) The Interosseous ligaments lie deeply between the lateral surfaces of the Metatarsal bones. The digital extremities of the Metatarsal bones are united by the Transverse Metatarsal ligament. This ligament also connects the great toe with all the Metatarsal bones.

The ligaments to be considered next are those which connect the Metatarsal bones with the phalanges of the toes.

METATARSO-PHALANGEAL LIGAMENTS

There are three ligaments to each joint, one Plantar and two Lateral ligaments.

CHART No. A12
Lateral Ligaments, Metatarso-Phalangeal Joint

1. **The Plantar Ligaments** are thick fibrous structures placed on the Plantar surface of the joints in the intervals between the lateral

ligaments, to which they are connected. They are attached to the Metatarsal bones and the first phalanges.

2. **The Lateral Ligaments** are strong rounded cords placed on each side of the joint, each being attached by one extremity to the Metatarsal bones and by the other to the first phalanges. The last of the ligaments of the foot to be described are those of the phalanges. There are three ligaments for each pair of phalanges, one Plantar and two Lateral ligaments.

The arrangements of these ligaments are similar to those of the Metatarso-Phalangeal ligaments which were described above.

This concludes this chapter, and we will next consider the chief muscles and tendons of the foot.

CHAPTER VII

MUSCLES AND TENDONS OF THE LEG

The tendons are generally described in conjunction with the muscles, as most of them are contiguous with the muscles.

Tendons are white fibrous cords varying in length and thickness, of considerable strength and devoid of elasticity, and have hardly any blood vessels. The fibers run parallel with each other and are firmly united together, having the appearance of a white, glistening cord.

The muscles are connected with the bones, ligaments and skin directly or through the intervention of fibrous structure called tendons. Where the muscles are attached to the bone the fibers terminate in blunt extremities upon the covering of the bone called Periosteum. Where the muscles are connected with the skin they either lie as a flattened layer beneath the skin or connected with connective tissue. The muscles vary extremely in their form; they may be long, short, broad, flat, round, etc. The arrangement of the fibers varies greatly in different muscles.

The muscles of the leg are completely invested by the Deep Fascia, which is a fibrous structure investing the whole of this region of the limb, excluding the inner surface of the Tibia. It is thick and dense in the upper exterior part of the leg, and gives attachment to some of the muscles of the leg, which we will consider later when we describe each muscle separately.

Some tendons of the muscles of the leg are attached to the ankle and foot, hence we must consider these muscles first before we take up the muscles of the foot. For convenience I have divided the muscles of the leg into three groups, namely, the Anterior, Posterior and Fibular groups.

EXTENSOR MUSCLES OF THE LEG

Anterior Group

This consists of four muscles:

1. Tibialis Anticus.
2. Extensor Proprius Pollicis.
3. Extensor Longus Digitorum.
4. Peroneus Tertius.

These muscles are located on the anterior part of the leg.

All anterior muscles are extensors of the leg and foot; in other words, they extend the foot, while those on the posterior surface are Flexor muscles and, consequently, flex the foot. We will now describe the above named four muscles:

1. **The Tibialis Anticus,** as the name implies, is situated on the anterior and outer side of the Tibia. It arises from the outer and upper two-thirds of the shaft of the Tibia, and from the Deep Fascia the fibers pass downward and terminate in a tendon which is apparent on the anterior surface of the muscle at the lower third of the leg. It is inserted into the inner and under surfaces of the Internal Cuneiform bone and the base of the Metatarsal bone of the large or great toe. (See Chart No. 12.)

2. **The Extensor Proprius Pollicis.**—This is the extensor muscle of the large toe proper, as the name implies. It is a thin, elongated and flattened muscle situated between the Tibialis Anticus and the Extensor Longus Digitorum, the next muscle which we are to consider. (See Chart No. 12.) It arises from the anterior surface of the Fibula, about the middle two-fourths of its length. The fibers pass downward and terminate in a tendon which occupies the anterior border of the muscle, crosses the bend of the ankle and is inserted into the base of the last phalanx of the great toe.

3. **The Extensor Longus Digitorum.**—This is the extensor muscle of the other four toes, as you will notice by the following description. It is an elongated, flattened muscle situated the most externally of all the muscles on the fore part of the leg. (See Chart 12.) It arises from the upper part of the Tibia and the upper three-fourths of the

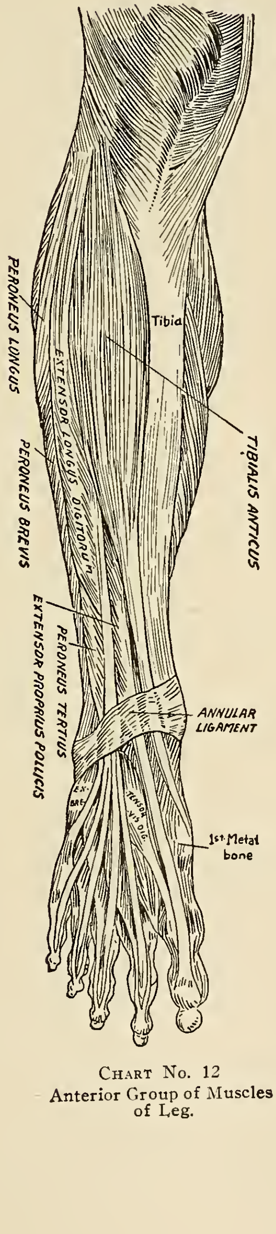


CHART No. 12
Anterior Group of Muscles of Leg.

anterior surface of the shaft of the Fibula, also from the Deep Fascia and the next muscles, called the Peroneus Longus and Peroneus Brevis. The fibers pass downward and terminate in a tendon which again divides into four slips, which run across the dorsum of the foot, and are inserted into the second and third phalanges of the four lesser toes.

4. **The Peroneus Tertius.**—This muscle is a small bundle of fibers and is claimed by some authorities to be part of the Extensor Longus Digitorum, and may be described as a fifth tendon of this muscle. The fibers arise from the lower fourth of the anterior surface of the Fibula. The tendon is inserted into the dorsal surface of the base of the Metatarsal bone of the little toe on the inner side.

POSTERIOR GROUP

The muscles of this group are subdivided into two layers, superficial and deep. The superficial layer constitutes a powerful muscular mass forming the calf of the leg.

Superficial Layer

This consists of three muscles:

1. Gastrócnemius.
2. Soleus.
3. Plantaris.

1. **The Gastrocnemius.**—The Gastrocnemius is the most superficial muscle, and forms the greater part of the calf. It arises by two heads, which are connected to the condyles of the Femur by two strong flat tendons. The inner head arises from the inner condyle, or inner side of the leg, while the external head arises from the external condyle, or the outer side of the leg. This muscle is tendinous along the middle, and each tendon expands into an aponeurosis which covers the posterior surface of that part of the muscle. From the anterior surface of these tendinous expansions muscular fibers are given off. The fibers continue downward and terminate with the fibers of the next muscle to be described, the Soleus, forming a

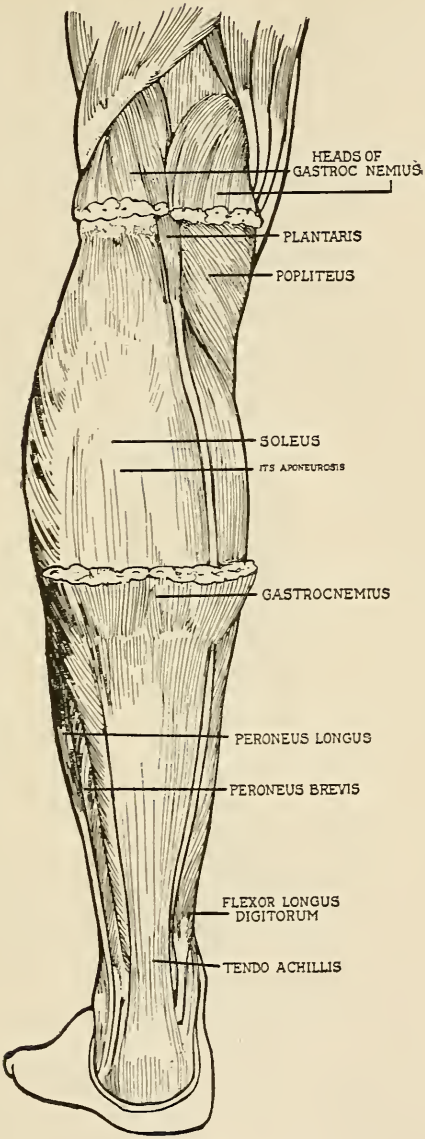


CHART No. 13
Posterior Group of Muscles of Leg,
Superficial Layer.

common tendon of the two muscles called the Tendo-Achillis. This tendon being of vast importance, it will be described separately. (See Chart No. 13.)

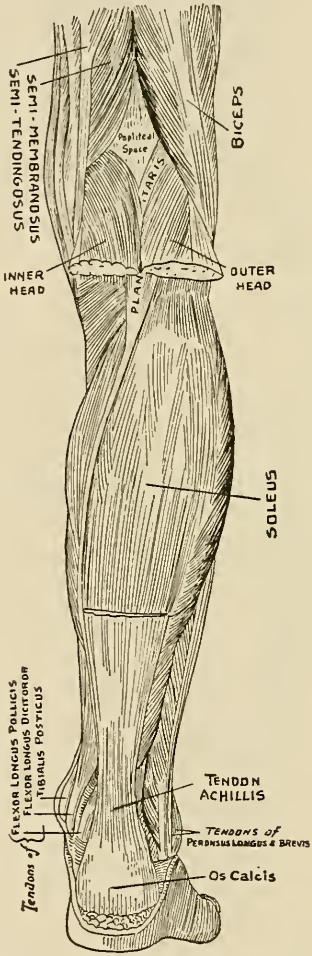


Chart No. 14
Posterior Group of Muscles of the Leg, Superficial Layer.

2. **The Soleus** is a broad flat muscle situated beneath the preceding muscle. It arises by tendinous fibers from the back part of the head of the Fibula, and from the upper third of the posterior surface

of its shaft and the middle third of the internal border of the Tibia. The fibers pass backward to an aponeurosis which covers the muscle, and this gradually becomes thicker and narrower and joins with the tendon of the Gastrocnemius to form the Tendo-Achillis. (See Chart No. 13.) **The Tendo-Achillis** is the thickest and strongest tendon in the body. It is about six inches in length, and commences about the middle of the back of the leg, being the common tendon of the two large muscles of the leg, namely, the Gastrocnemius and Soleus, and is inserted into the lower part of the posterior surface of the Os Calcis. (See Chart No. 13.) The tendon spreads out somewhat at its lower end. This tendon can be readily observed when standing on tip toes.

3. **The Plantaris** is an extremely diminutive muscle, placed between the foregoing two muscles, the Gastrocnemius and Soleus, and has a long and delicate tendon. It arises from a ridge on the Femur and the posterior ligament of the knee joint, the fibers form a small fusiform belly, about three or four inches in length, terminating in a long slender tendon which crosses obliquely the two muscles of the calf and running along the inner border of the Tendo-Achillis, and is inserted with it into the posterior part of the Os Calcis. (See Chart No. 13.) The muscles of the calf possess great power, and are constantly called into use in standing, walking, dancing and leaping, thus the large size they usually present when active.

Deep Layer

This consists of four muscles:

1. Popliteus.
2. Flexor Longus Pollicis.
3. Flexor Longus Digitorum.
4. Tibialis Posticus.

Before describing the above muscles, we must consider the Deep Transverse Fascia of the leg. This is a broad transverse intermuscular Septum interposed between the superficial and deep muscles of the posterior group. On each side it is attached to the margins of the Tibia and Fibula. This Fascia is thickened above and below,

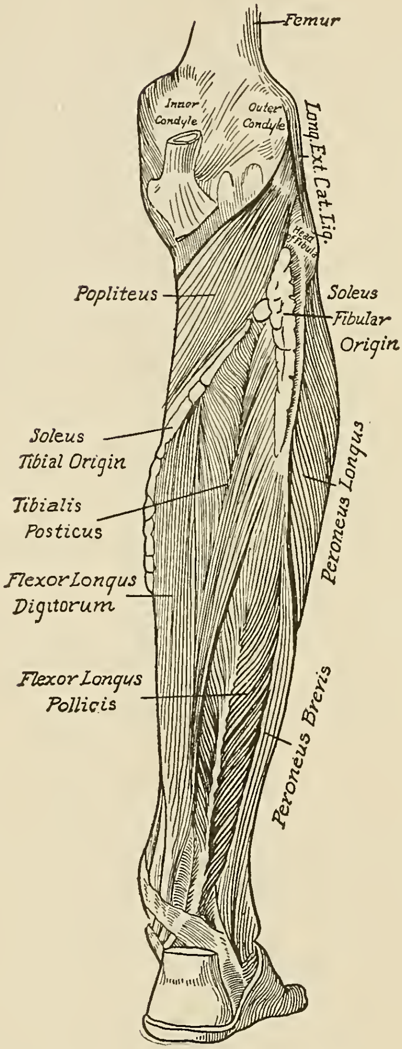


CHART No. 15
Deep Layer of Muscles of Back of Leg.

but in the middle it is thin. It continues onward internally between the ankle and the heel.

1. **The Popliteus Muscle** is a thin, flat triangular muscle. It arises by a strong flat tendon, about an inch in length, on the outer side of the external condyle of the Femur, and is inserted into the posterior surface of the shaft of the Tibia. Notice the triangular shape of the muscle in the back part of the knee joint in Chart No. 15.

2. **The Flexor Longus Pollicis** is situated on the Fibular side of the leg, and is the most superficial and largest of the next three muscles of the leg. It arises from the lower two-thirds of the posterior surface of the shaft of the Fibula and from the Fascia. The fibers pass obliquely downward and backward and terminate in a round tendon which passes through a groove on the posterior surface of the Tibia, then through another groove on the posterior surface of the Astragalus, and along a third groove of the Os Calcis into the sole of the foot, where it runs forward and is inserted into the base of the last phalanx of the great toe. You can readily see that the action of this muscle is to flex the great toe. (See Charts Nos. 15 and 17.)

3. **The Flexor Longus Digitorum** is situated on the Tibial side of the leg. It arises from the posterior surface of the shaft of the Tibia and from the Transverse Fascia, the fibers terminating in a tendon. This tendon passes behind the Malleolus through a groove, and passes obliquely forward and outward beneath the arch of the Os Calcis into the sole of the foot, and finally divides into four separate tendons, which are inserted into the bases of the last phalanges of the four lesser toes. Its action is, as the description would imply, to flex the second, third, fourth and fifth toes. (See Charts Nos. 15 and 17.)

4. **The Tibialis Posticus** lies between the two preceding muscles, and is the most deeply seated of all the muscles of the leg. It commences by two pointed processes and arises from the interosseous membrane from the posterior surface of the shaft of the Tibia, and from the upper two-thirds of the internal surface of the Fibula. The fibers pass downward and terminate in a tendon which passes through

a groove behind the inner Malleolus, thence beneath the Inferior Calcaneo-Scaphoid ligament, and is inserted into the Scaphoid and internal Cuneiform bones. It also gives off fibrous expansions, one of which passes backward to the Os Calcis, others outward to the Middle and External Cuneiform and Cuboid, and some forward to the bases of the second, third and fourth Metatarsal bones. (See Charts Nos. 15 and 18.) The action of this muscle is a direct extensor of the Tarsus upon the leg, and also turns the sole of the foot inward in conjunction with the Tibialis Anticus.

FIBULAR GROUP

This consists of two muscles:

1. Peroneus Longus.
2. Peroneus Brevis.

1. **The Peroneus Longus** is situated at the upper part of the outer side of the leg, and is the more superficial of the two muscles. It arises from the head and upper two-thirds of the outer surface of the shaft of the Fibula, from the Fascia and intermuscular septum. It terminates in a long tendon which passes behind the outer Malleolus in a groove. It is then reflected obliquely across the outer side of the Os Calcis; then in another groove on the under surface of the Cuboid bone. It then crosses obliquely the sole of the foot, and is inserted into the outer side of the base of the Metatarsal bone of the great toe and the Internal Cuneiform bone. Occasionally it sends a slip to the base of the second Metatarsal bone. Its action is also to extend the foot upon the leg, just opposite to that of the Tibialis Anticus and the Peroneus Tertius, which are flexors of the foot. (See Charts Nos. 15 and A16.)

2. **Peroneus Brevis** lies beneath the Peroneus Longus and is shorter and smaller. It arises from the lower two-thirds of the external surface of the shaft of the Fibula, and from the intermuscular septum. The fibers pass vertically downward and terminate in a tendon which runs in front of that of the preceding muscle through

the same groove, behind the External Malleolus; it then passes to the outer side of the Os Calcis and is finally inserted into the dorsal surface of the base of the Metatarsal bone of the little toe on the outer side.

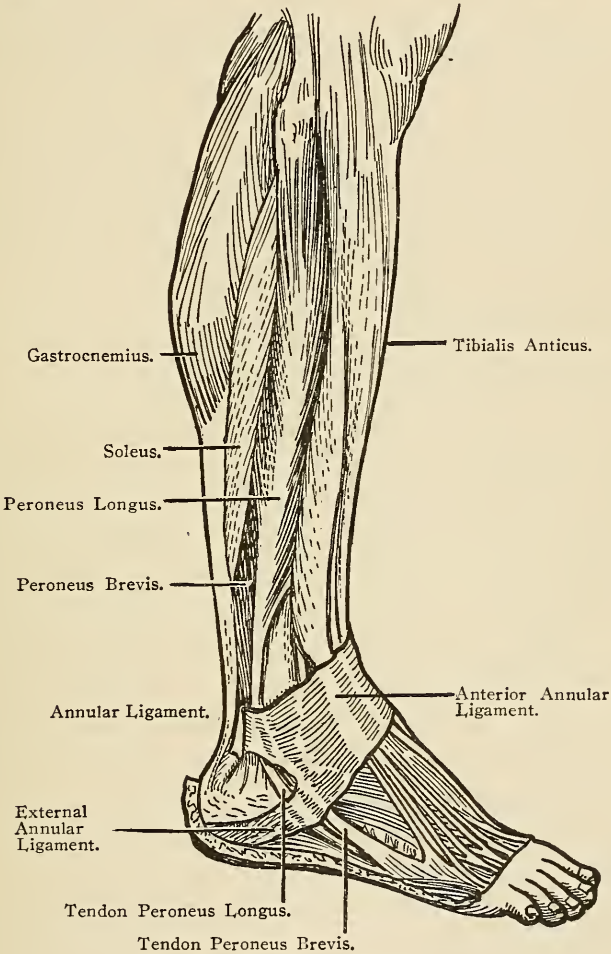


Chart No. A16
External View of Right Leg, Showing the Peroneus Longus and Brevis.

From the above it can be seen that the Peroneus Longus and Brevis muscles serve to steady the leg upon the foot in standing upon one foot. (See Charts Nos. 15 and A16.)

CHAPTER VIII

MUSCLES AND TENDONS OF THE FOOT

Under this chapter we are to consider the muscles and tendons of the foot, and in this connection I must call your attention to four structures which we find in the foot and which are closely related to the muscles and tendons and will be described separately. They are the

1. Anterior Annular ligament.
2. Internal Annular ligament.
3. External Annular ligament.
4. Plantar Fascia.

1. **The Anterior Annular Ligament** consists of a superior or vertical portion which binds down the extensor tendons as they descend on the front of the Tibia and Fibula, and an inferior or horizontal portion which retains the tendons in connection with the Tarsus. The vertical portion is attached externally to the lower end of the Fibula, internally to the Tibia and above is continuous with the fascia of the leg. The horizontal portion is attached externally to the upper surface of the Os Calcis. It passes upward and inward as a double layer, one layer passing in front and the other behind the Peroneus Tertius and Extensor Longus Digitorum. Later the two layers join together, forming a sort of a loop in which the tendons are enclosed. From the inner extremity of this loop two bands of fibers are given off, one passing upward and inward to be attached to the Internal Malleolus, the other passing downward and inward to be attached to the Plantar Fascia. This ligament is a very important structure of the ankle joint, as you will notice by referring to Chart No. 12 and Chart No. A16.

2. **The Internal Annular Ligament** is a strong fibrous band which extends from the inner Malleolus above to the inner margin of the Os

Calcis below, converting a series of grooves in this situation into canals for the passage of the tendons of the flexor muscles into the sole of the foot. It is continuous above with the Deep Fascia of the leg and by its lower border with the Plantar Fascia.

3. **The External Annular Ligament** extends from the outer Malleolus to the outer surface of the Os Calcis and is a shorter fibrous

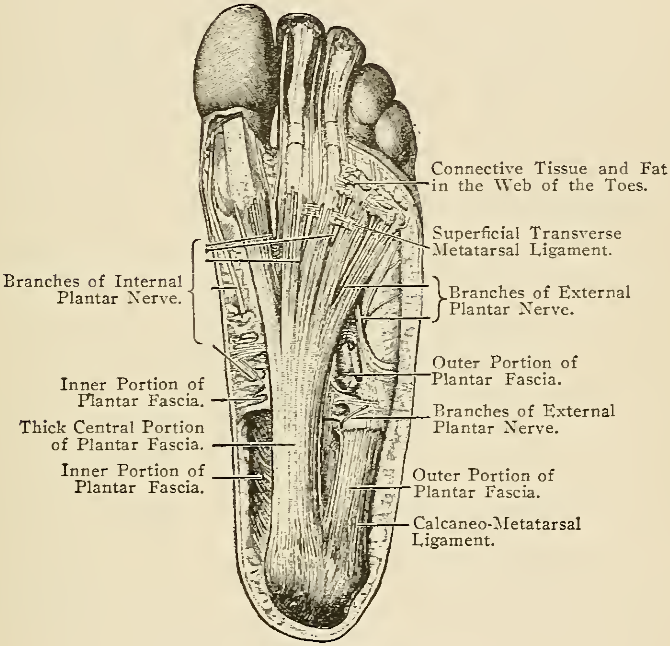


CHART NO. B16
The Plantar Fascia and Plantar Cutaneous Nerves.

structure which binds down the tendons of Peronei muscles. (See Chart No. A16.)

4. **The Plantar Fascia** is the densest of all the fibrous membranes. It is of great strength and consists of dense pearly-white fibers disposed for the most part longitudinally. It is divided into a central and two lateral portions, namely, the outer and inner portions. The central portion is the thickest, is narrow behind and attached to the

inner tubercle of the Os Calcis, becomes broader and thinner in front and divides near the heads of the Metatarsal bones into five processes, one for each toe. Each of these processes again subdivides into two, opposite the Metatarso-Phalangeal joints, a superficial and a deep. The superficial one is inserted into the skin. The deep divides into two slips which embrace the sides of the flexor tendons of the toes and laterally with the Transverse Metatarsal ligaments, thus forming a series of arches through which the tendons of the short and long flexor muscles pass to the toes.

The Central Portion of this Fascia is continuous with the lateral portion on each side and sends off several septums upward into the foot.

The Outer Portion covers the under surface of the Abductor Minimi Digiti muscle, which will be described later. It is thick behind and thin in front, and extends from the Os Calcis forward to the base of the fifth Metatarsal bone where it is attached to its outer side. It is continuous internally with the middle portion of the Plantar Fascia and externally with the Dorsal Fascia.

The Inner Portion is very thin and covers the Abductor Pollicis muscle, another muscle which will be described later. It is attached behind to the Internal Annular ligament and is continuous around the side of the foot with the Dorsal Fascia and externally with the middle portion of the Plantar Fascia.

We will now describe the muscles of the foot, and for your convenience I have divided these muscles into two main groups, namely:

1. The muscles of the Dorsum of the foot.
2. The muscles of the Plantar surface of the foot.

DORSAL REGION

1. **The Dorsal Region** has one muscle, namely:

The Extensor Brevis Digitorum.—It is a broad, thin muscle which arises from the outer side of the Os Calcis from the External Calcaneo-Astragaloid ligament and from the horizontal portion of the Anterior Annular ligament. It passes obliquely across the Dorsum of the foot and terminates in four tendons. The innermost, which is the largest of the four tendons, is inserted into the first phalanx of the great toe; the other three are inserted into the outer sides of the long extensor tendons of the second, third and fourth toes. (See Charts Nos. 12 and C16.)

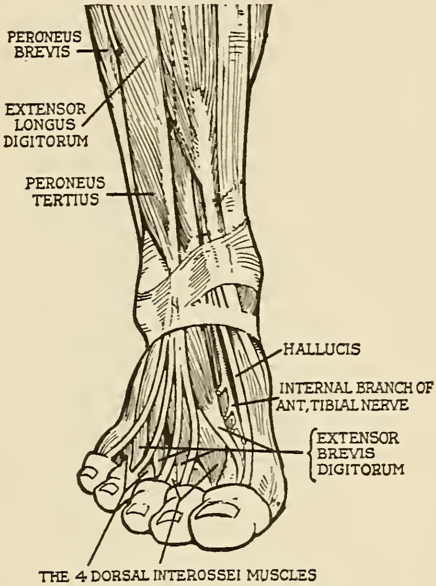


CHART No. C16
Showing the Extensor Brevis Digitorum and Its Insertion.

PLANTAR REGION

2. **The Plantar Region** is divided into four layers, and each layer consists of several muscles. We will therefore describe these muscles under their respective layers.

FIRST LAYER

This consists of three muscles, namely:

1. Abductor Pollicis.
2. Flexor Brevis Digitorum.
3. Abductor Minimi Digiti.

1. **The Abductor Pollicis** lies along the inner border of the foot. It arises from the under surface of the Os Calcis from the Internal Annular ligament, from the Plantar Fascia and from the Intermuscular Septum. The fibers terminate in a tendon and are inserted together

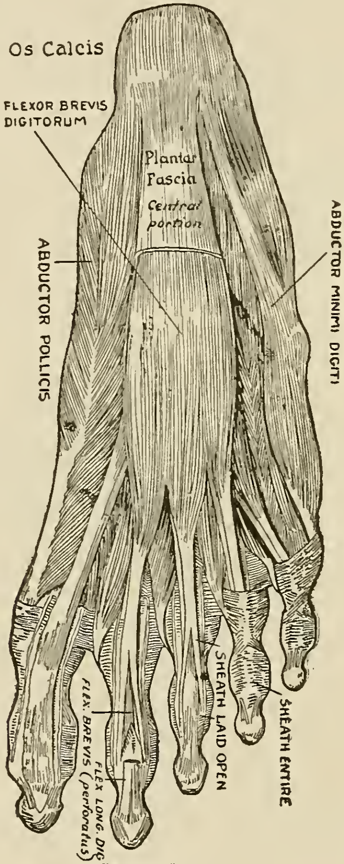


CHART No. 16
Muscles of the Sole of the Foot,
First Layer.

with the innermost tendon of the Flexor Brevis Pollicis into the inner side of the base of the first phalanx of the great toe. (See Chart No. 16.)

2. **The Flexor Brevis Digitorum** lies in the middle of the sole of the foot, immediately beneath the Plantar Fascia with which it is

firmly united. It arises from the under surface of the Os Calcis, from the central part of the Plantar Fascia and from the Intermuscular Septum; it then passes forward and is divided into four tendons, which are inserted into the four lesser toes. Opposite the middle of the first Phalanx of each toe the tendon presents a longitudinal slit to allow the passage of the corresponding tendon of the Flexor Longus Digitorum; the tendon of the Flexor Brevis Digitorum then reunites and again divides into two processes, which are inserted into the sides of the second Phalanges of the four lesser toes. (See Chart No. 16.)

3. **The Abductor Minimi Digiti** lies along the outer border of the foot. It arises by a very broad origin from the under surface of the Os Calcis, from the Plantar Fascia and from the Intermuscular Septum, and terminates in a tendon which is inserted, together with the tendon of the Flexor Brevis Digitorum of the little toe, into the outer side of the base of the first Phalanx of the little toe. (See Chart No. 16.)

SECOND LAYER

This layer has five muscles, namely:

1. Flexor Accessorius.
2. Lumbricales (four in number).

1. **The Flexor Accessorius** arises by two heads, the inner or larger head being attached to the inner surface of the Os Calcis and to the Calcaneo-Scaphoid ligament. The outer head is flat and tendinous and is attached to the under surface of the Os Calcis and to the long Plantar ligament. The two heads join at an acute angle and are inserted into the outer margin and the upper and under surfaces of the tendon of the Flexor Longus Digitorum. (See Chart No. 17.)

2. **The Lumbricales** are four small muscles, accessory to the tendons of the Flexor Longus Digitorum. They arise from the tendons of the long Flexor as far back as their angle of division, each arising from two tendons of the long Flexor, except the internal one. Each

muscle terminates in a tendon which passes forward on the inner side of each of the lesser toes and is inserted into the long Extensor and base of the first Phalanx of the corresponding toe.

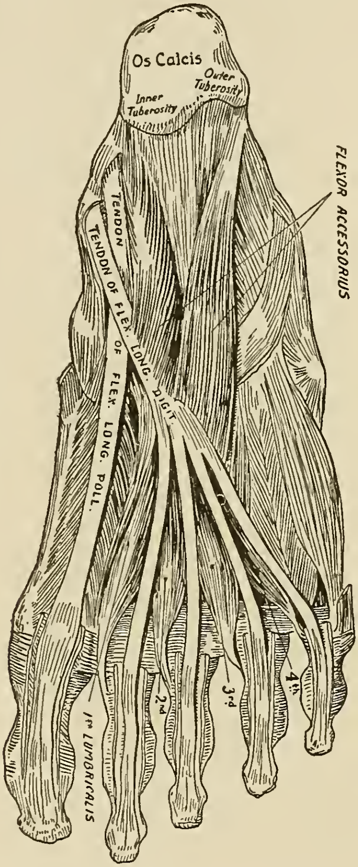


CHART No. 17
Muscles of the Sole of the Foot,
Second Layer.

THIRD LAYER

This layer has four muscles, namely:

1. Flexor Brevis Pollicis.
2. Adductor Pollicis.
3. Flexor Brevis Minimi Digiti.
4. Transversus Pedis.

1. **The Flexor Brevis Pollicis** arises by a pointed tendinous process from the inner border of the Cuboid bone, from the External Cuneiform bone and from the prolongation of the tendon of the Tibialis Posticus. The muscle divides into two portions which are inserted as follows:

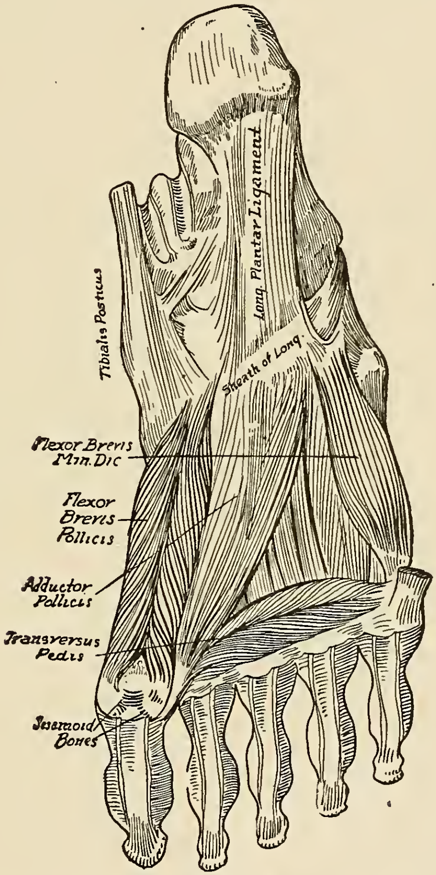


CHART No. 18
Muscles of Sole of the Foot, Third Layer.

One on the inner side of the base of the first phalanx of the great toes, blended together with the Abductor Pollicis; the other portion is inserted into the outer side of the first Phalanx of the great toe and blended together with the Adductor Pollicis and the tendon of the Flexor Longus Pollicis. (See Chart No. 18.)

2. **The Adductor Pollicis** is a large, thick, fleshy muscle passing obliquely across the foot and occupying the hollow space between the four inner Metatarsal bones. It arises from the Tarsal extremities of the second, third and fourth Metatarsal bones and from the tendon of the Peroneus Longus and is inserted, together with outer portion of the Flexor Brevis Pollicis, into the outer side of the base of the first Phalanx of the great toe. (See Chart No. 18.)

3. **The Flexor Brevis Minimi Digiti** lies on the Metatarsal bone of the little toe and arises from the base of that bone and from the Peroneus Longus, and is inserted into the base of the first Phalanx of the little toe on its outer side. (See Chart No. 18.)

4. **The Transversus Pedis** is a narrow, flat muscular fasciculus stretched transversely across the heads of the Metatarsal bones. It arises from the under surface of the head of the fifth Metatarsal bone and from the Transverse ligament of the Metatarsus and is inserted on the outer side of the first Phalanx of the great toe. Its fibers blend with the tendon of the Adductor Pollicis. The action of the Transversus Pedis increases the arching of the foot and abducts the great toe. (See Chart No. 18.)

FOURTH LAYER

This layer consists of seven Interossei muscles. There are four in the Dorsum of the foot and three in the Plantar surface.

The Dorsal Interossei are four in number and are situated between the Metatarsal bones. They arise by two heads from the adjacent sides of the Metatarsal bones; their tendons are inserted into the bases of the first Phalanges of the middle three lesser toes and into the common Extensor tendon. The first Dorsal Interosseous muscle is inserted into the outer sides of the second toe; the other three are inserted into the inner side of the second, third and fourth toes. (See Chart No. 19.)

The Plantar Interossei, three in number, lie beneath the third, fourth and fifth Metatarsal bones. They are single muscles and arise from the base and the shaft of their respective Metatarsal bones, and are inserted into the inner sides of the bases of the first Phalanges of the same toes and into the common Extensor tendon. (See Chart No. 20.) All the muscles of the foot act upon the toes, and for the purpose of description as regards their action may be grouped as Abductors, Adductors, Flexors or Extensors. And, whereas the

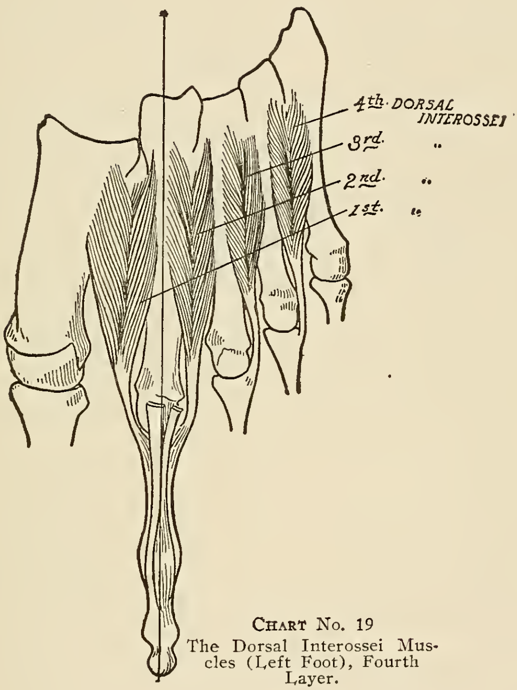


Chart No. 19
The Dorsal Interossei Muscles (Left Foot), Fourth Layer.

muscles of the foot are of prime importance in your work, it is well that I give you an idea of the function of each muscle.

The Abductors are the Dorsal Interossei, the Abductor Pollicis and the Abductor Minimi Digiti. The first Dorsal Interosseous muscle draws the second toe inward toward the great toe; the second muscle draws the same toe outward. The third muscle draws the third toe and the fourth muscle draws the fourth toe in the same direction; they also flex the proximal Phalanges and extend the two terminal Phalanges. The Abductor Pollicis abducts the great toe from the other toes and also flexes the proximal Phalanx of the great toe. The Abductor Minimi Digiti acts in the same manner on the little toe.

The Adductors are the Plantar Interossei, the Adductor Pollicis

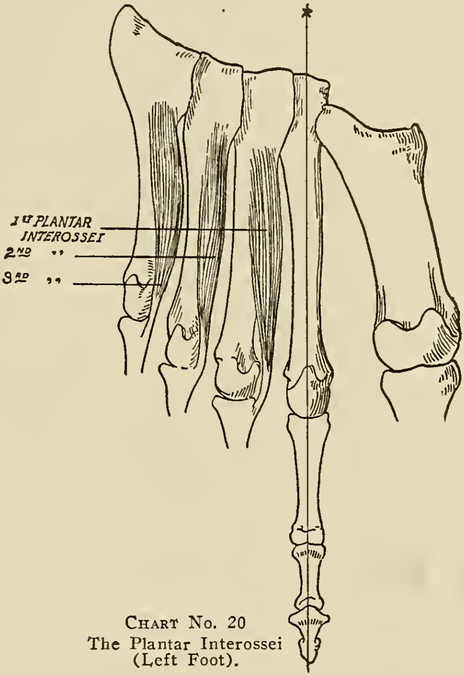


Chart No. 20
The Plantar Interossei
(Left Foot).

and the Transversus Pedis. The Plantar Interosseous muscles draw the third, fourth and fifth toes toward the second toe, also flex the proximal Phalanges and extend the two terminal Phalanges. The Adductor Pollicis adducts the great toe toward the second toe and also assists in flexing this toe. The Transversus Pedis approximates all the toes and thus increases the curve of the Transverse Arch of the Metatarsus.

The Flexors are the Flexor Brevis Digitorum, the Flexor Accessorius, the Flexor Brevis Pollicis, the Flexor Brevis Minimi Digiti and the Lumbricales. The Flexor Brevis Digitorum flexes the second Phalanges upon the first and brings the toes together. The Flexor Accessorius assists the long flexor of the toes and converts the oblique pull of the tendon of that muscle into a direct backward pull upon the toes. The Flexor Brevis Minimi Digiti flexes the little toe and draws its Metatarsal bone downward and inward. The Lumbricales assist in flexing the proximal Phalanges and, by their insertion into the long Extensor tendon, aid in straightening the two terminal Phalanges.

The Extensors.—In this group there is only one, the Extensor Brevis Digitorum. It extends the first Phalanx of the great toe and assists the long Extensor in extending the next three toes; it also gives to the toes an outward direction when extended. This concludes the description of the muscles and tendons of the leg, ankle and foot, and before giving you the arteries, veins and nerves it would be advisable to study these muscles again by comparing them with the charts given in this book and master them thoroughly, as they are of vital importance in malformations of the foot.

CHAPTER IX

THE ARTERIES OF THE FOOT

Under Chapter V I gave you a general description of the structure of the arteries, also the mode of distributions, and now we are to describe each artery and branch of the leg and foot separately. Before we can comprehend the origin and division of these arteries, I must refer you back to Chapter V, in which you will find a description of the circulation of the blood.

The blood is forced through the large vessels by the heart, which acts as a pump. These vessels or arteries have branches and capillaries. It is not necessary to consider all the arteries of the body in this book, as we are only interested in those vessels which distribute the blood supply to the lower limb and foot. For this reason we will commence at the knee joint and go down. The first artery to be considered is the Popliteal artery, which is a continuation of the largest artery in the thigh, namely, the Femoral artery.

The Popliteal Artery commences at the junction of the middle and lower third of the thigh, and passes obliquely downward and outward behind the knee joint to the lower border of the Popliteus muscle, where it divides into the Anterior and Posterior Tibial arteries. (See Charts Nos. 21 and 22.) This brings us down to the arteries of the leg proper. The arteries of the leg are divided into two main arteries and their branches, which will be described under their respective headings, namely, the Anterior Tibial artery and the Posterior Tibial artery.

The Anterior Tibial Artery commences at the bifurcation of the Popliteal artery at the lower border of the Popliteus muscle, passes forward between the two heads of the Tibialis Posticus muscle and through an aperture left between the bones to the deep part of the front of the leg; it then descends on the anterior aspect of the Tibia

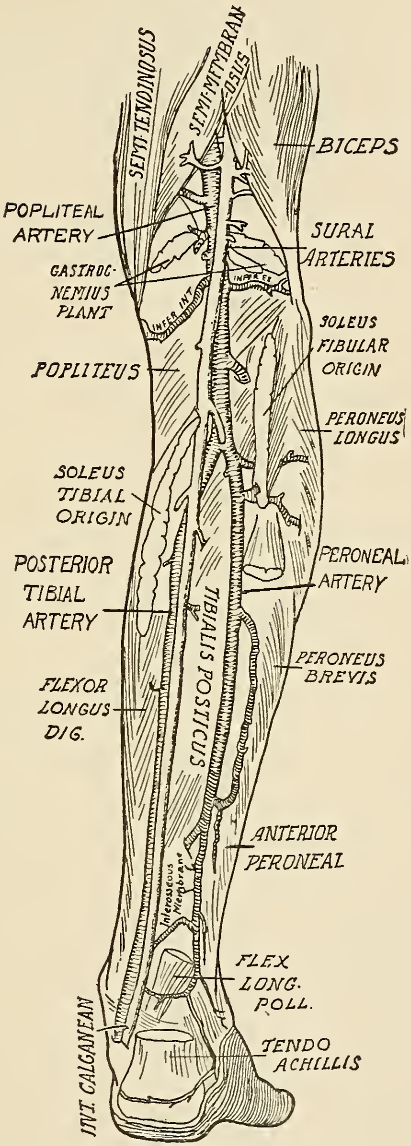


Chart No. 21
The Popliteal, Posterior Tibial and Peroneal Arteries.

to the bend of the ankle joint, where it lies more superficially and becomes the Dorsalis Pedis artery. (See Chart No. 22.) The Anterior Tibial artery is accompanied by two veins, called venae comites, which lie one on either side of the artery. The Anterior Tibial nerve lies at first to its outer side, and about the middle of the leg is placed superficially to it.

At the lower part of the artery the nerve again is on the outer side. The Anterior Tibial artery is divided into four branches, namely:

1. Recurrent Tibial.
2. Muscular.
3. Internal Malleolar.
4. External Malleolar.

1. **The Recurrent Tibial Branch** arises from the Anterior Tibial artery as soon as that vessel has passed through the aperture about the knee joint. It ascends in the Tibialis Anticus muscle and ramifies on the front and sides of the knee joint, anastomosing with the articular branches of the Popliteal and the Anastomotica Magna. (See Chart No. 22.)

2. **The Muscular Branches** are numerous. They are distributed to the muscles which lie on either side of the vessels, some piercing the Deep Fascia to supply the Integument, others passing through the Interosseous membrane and anastomosing with the branches of the Posterior Tibial and Peroneal arteries. The Malleolar arteries supply the ankle joint.

3. **The Internal Malleolar Branch** arises about two inches above the ankle joint and passes beneath the tendons of the Extensor Proprius Pollicis and Tibialis Anticus to the inner ankle, upon which it ramifies, anastomosing with branches of the Posterior Tibial and Internal Plantar arteries and with the Internal Calcanean branch of the Posterior Tibial artery. (See Chart No. 22.)

4. **The External Malleolar Branch** passes beneath the tendons of the Extensor Longus Digitorum and Peroneus Tertius and supplies the outer ankle, anastomosing with the Anterior Peroneal artery and with ascending branches from the Tarsal branch of the Dorsalis

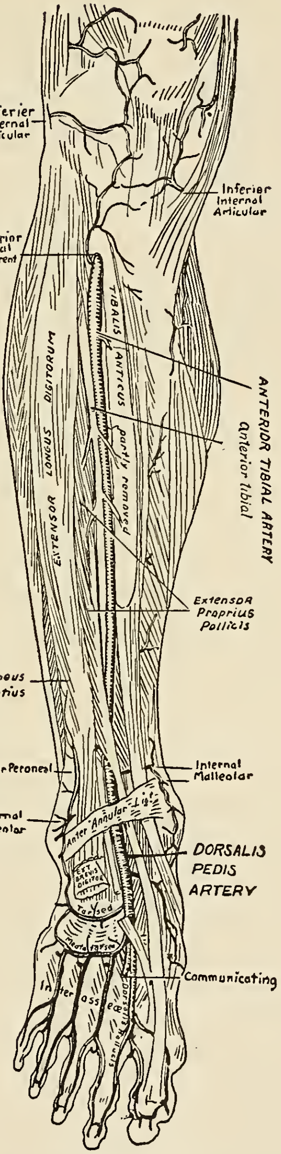


CHART No. 22
The Anterior Tibial and Dorsalis
Pedis Arteries.

Pedis. (See Chart No. 22.) To facilitate the study of the arteries of the leg and foot, it is necessary that I describe the Dorsalis Pedis artery and its branches before we take up the Posterior Tibial artery and its branches, as the Dorsalis Pedis is a continuation of the Anterior Tibial artery which was just described.

THE DORSALIS PEDIS ARTERY

Commences at the bend of the ankle as a continuation of the Anterior Tibial artery and passes along the Tibial side of the foot to the back part of the first Interosseous space, where it divides into five branches, namely: (See Chart No. 22.)

Branches of the Dcrsalis Pedis Artery

1. Tarsal.
2. Metatarsal.
3. Interosseous.
4. Dorsalis Pollicis.
5. Communicating.

1. **The Tarsal Branch** arises from the Dorsalis Pedis as that vessel crosses the Scaphoid bone. It passes outward, lying upon the Tarsal bones and is covered by the Extensor Brevis Digitorum. It supplies that muscle and the Tarsus and anastomoses with the branches of the Metatarsal, External Malleolar, Peroneal and External Plantar arteries. (See Charts Nos. 22 and A23.)

2. **The Metatarsal Branch** arises a little anterior to the preceding, and passes outward to the outer part of the foot over the bases of the Metatarsal bones beneath the tendon of the short Extensor. It anastomoses with the Tarsal and External Plantar arteries. It gives off three branches, the Interosseous. (See Charts Nos. 22 and A23.)

3. **The Interosseous Branches** are three in number, passing forward upon the three outer Dorsal Interossei muscles and between the toes and divides into two collateral Dorsal branches for the adjoining toes. At the back part these vessels receive the Posterior Perforating branches from the Plantar arch and at the fore part they

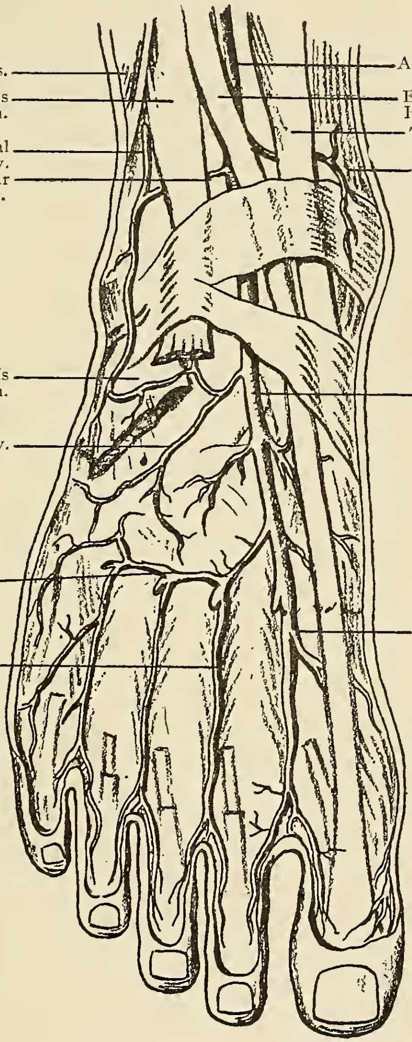


CHART No. A23
The Dorsalis Pedis Artery and Its Branches.

are joined by the Anterior Perforating branches from the Plantar arch, the outermost Interosseous artery sending off an additional branch, which supplies the outer side of the little toe. (See Chart No. A23.)

4. **The Dorsalis Pollicis** runs along the outer border of the first Metatarsal bone and between the first and second toes and again divides into two branches, one of which passes inward beneath the tendon of the Extensor Proprius Pollicis and is distributed to the inner border of the great toe. The outer branch bifurcates to supply the adjoining sides of the great and second toes. (See Chart No. A23.)

5. **The Communicating Branch** dips down into the sole of the foot between the two heads of the first Dorsal Interosseous muscle and communicates with the termination of the External Plantar artery to complete the Plantar arch. It here gives off two digital branches: one runs along the inner side of the great toe on its Plantar surface, the other forward along the first Interosseous space and bifurcates for the supply of the adjacent sides of the great and second toes. (See Chart No. 22.)

THE POSTERIOR TIBIAL ARTERY

Is of large size, which extends obliquely downward from the lower border of the Popliteus muscle along the Tibial side of the leg to the Fossa between the inner ankle and the heel, where it divides into the Internal Plantar and External Plantar arteries. It lies upon the Tibialis Posticus and Flexor Digitorum muscles and on the Tibia and back part of the ankle joint at its lower part, running parallel with the Tendo-Achillis. It is accompanied by two veins and the Posterior Tibial nerve. (See Chart No. 21.) The branches of the Posterior Tibial artery are divided as follows:

1. The Peroneal.
2. Anterior Peroneal.
3. Muscular.
4. Nutrient.
5. Communicating.
6. Internal Calcanean.

1. **The Peroneal Artery** lies deeply seated along the back part of the Fibular side of the leg. It arises from the Posterior Tibial artery an inch below the lower border of the Popliteus muscle, passes obliquely outward to the Fibula and then descends along the inner border of that bone through the fibers of the Flexor Longus Pollicis to the lower third of the leg, where it gives off the Anterior Peroneal branch. It then passes across the articulation between the Tibia and Fibula to the outer side of the Os Calcis, supplying the neighboring muscles and back of the ankle. It anastomoses with the External Malleolar, Tarsal and External Plantar arteries. The Peroneal artery in its course gives off branches to the Soleus, Tibialis Posticus, Flexor Longus Pollicis, Peronei muscles and a nutrient branch to the Fibula. (See Chart No. 21.)

2. **The Anterior Peroneal Branch** pierces the Interosseous membrane about two inches above the External Malleolus to reach the fore part of the leg, and passing down beneath the Peroneus Tertius to the outer ankle ramifies on the front and outer side of the Tarsus, anastomosing with the External Malleolar and Tarsal arteries. (See Chart No. 22.)

3. **The Muscular Branches** of the Posterior Tibial are distributed to the Soleus and deep muscles along the back of the leg.

4. **The Nutrient Branch** arises from the Posterior Tibial, near its origin, and after supplying a few muscular branches enters the nutrient canal of the Tibia which it traverses obliquely from above downward. This is the largest nutrient artery of bone in the body.

5. **The Communicating Branch** to the Peroneal runs transversely across the back of the Tibia about two inches above its lower end, passing beneath the Flexor Longus Pollicis. (See Chart No. 23.)

6. **The Internal Calcanean** are several large arteries which arise from the Posterior Tibial just before its division; they are distributed to the fat and integument behind the Tendo-Achillis and about the heel, also to the muscles on the inner side of the sole, anastomosing with the Peroneal and Internal Malleolar arteries. (See Chart No. 21.)

THE INTERNAL PLANTAR ARTERY

Is the smaller of the two Plantar arteries and passes along the inner side of the foot. It is first situated above the Abductor Pollicis and then between it and the Flexor Brevis Digitorum, both of which it supplies. At the base of the first Metatarsal bone it passes along the inner border of the great toe. (See Charts Nos. 23 and 24.)

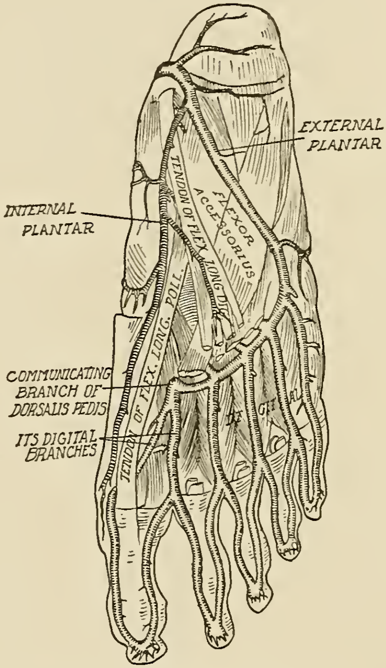


Chart No. 23
The Plantar Arteries. (Deep View)

THE EXTERNAL PLANTAR ARTERY

Is much larger than the Internal, passes obliquely outward and forward to the base of the fifth Metatarsal bone; it then turns inward between the bases of the first and second Metatarsal bones, where it anastomoses with the communicating branch of the Dorsalis Pedis artery, thus completing the Plantar arch at its commencement. It is placed between the Os Calcis and Abductor Pollicis, then between the Flexor Brevis Digitorum and Flexor Accessorius; as it passes on to the little toe, it lies between the Flexor Brevis Digitorum and Abductor Minimi Digiti. The remainder of the artery extends from the base of the Metatarsal bone of the little toe to the back part of the first Interosseous space and forms the Plantar arch. The branches

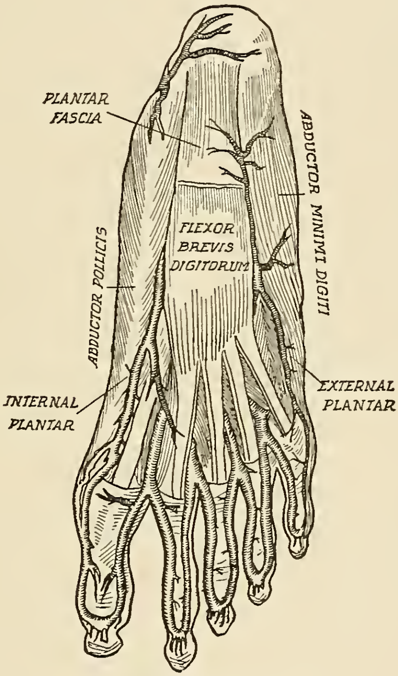


CHART No. 24
Showing Plantar Arteries.
(Superficial View)

of the Plantar arch, besides distributing numerous branches to the muscles and integument in the sole, are: (See Charts Nos. 23 and 24.)

1. The Posterior Perforating.
2. The Digital or Anterior Perforating.

1. **The Posterior Perforating** are three small branches which ascend through the back part of the three outer Interosseous spaces,

and anastomose with the Interosseous branches from the Metatarsal artery. (See Chart No. 23.)

2. **The Digital Branches** are four in number and supply the three outer toes and half of the second toe. The first passes along the outer side of the little toe. The second, third and fourth run along the Interosseous spaces and divide into two collateral branches, which supply the adjacent sides of the three outer toes and the outer side of the second toe. Each Digital artery sends upward, through the fore part of the corresponding Metatarsal space, a small branch which communicates with the Interosseous branches of the Metatarsal artery and are called the Anterior Perforating branches. (See Charts Nos. 23 and 24.) This concludes the description of the arteries of the leg and foot, and from the arrangement of these arteries you can readily see the perfect system of blood supply to all the tissues which are found in these parts. Should any disturbance arise in the blood vessels of the foot, it is liable to cause a great many conditions, such as swelling, enlarged joints, etc.

It is very important also to bear in mind the location and distribution of these arteries when using mechanical appliances in correcting foot disturbances.

CHAPTER X

THE VEINS OF THE LEG AND FOOT

In considering the veins it is only necessary to give here a general outline of their mode of distribution and to describe a few of the chief veins of the leg and foot in order to understand their relation to the arteries, etc.

The veins are vessels which serve to return the blood from the capillaries of the different parts of the body to the heart. They consist of two distinct sets of vessels, the Pulmonary and Systemic. Whereas we are only to describe the veins of the lower extremity, we will only take the Systemic veins into consideration. The veins, like the arteries, are found in nearly every tissue of the body. They commence by minute plexuses which receive the blood from the capillaries.

The branches which have their commencement in these plexuses unite together into trunks, and these as they pass toward the heart increase in size. The veins are larger and altogether more numerous than the arteries, hence the entire capacity of the venous system is much greater than that of the arterial system. The veins communicate very freely with one another.

The Systemic veins are divided into the superficial and deep veins. The superficial veins are placed beneath the integument between the Superficial Fascia; they return the blood from these structures and communicate with the deep veins by perforating the Deep Fascia. The deep veins accompany the arteries and are usually enclosed in the same sheath with those vessels, and are called for that reason the Venæ Comites of those vessels.

Both sets of veins are provided with valves which are more numerous in the deep than in the superficial set. The superficial veins of

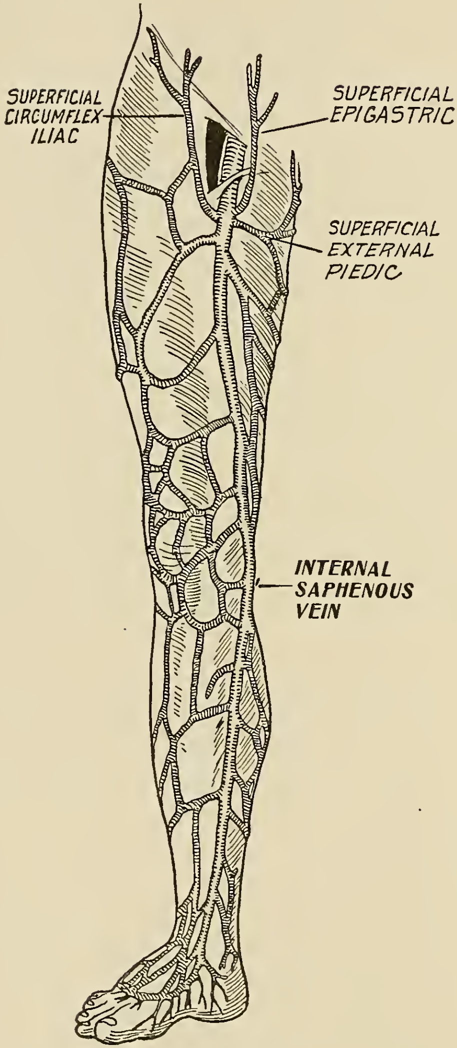


CHART No. 25
The Internal or Large Saphenous Vein and Its Branches.

the lower extremity are two, the Internal or Long Saphenous, and the External or Short Saphenous veins. Before describing these two veins, we must describe the veins of the foot and so upward, as the blood returns from the most distant point and ascends toward the heart.

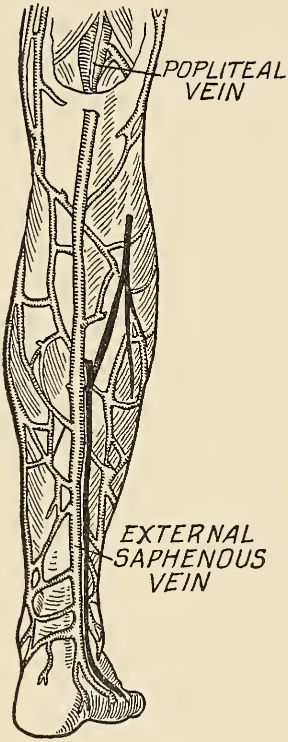


CHART No. 26
External or Short Saphenous
Vein.

On the Dorsum of the foot there is a Venous arch situated in the superficial structures, over the anterior extremities of the Metatarsal bones, which terminates internally in the Long Saphenous vein and externally in the Short Saphenous vein. (See Chart No. 25.)

The Internal or Long Saphenous Vein commences at the inner side of the Venous arch on the Dorsum of the foot. It ascends in front of the inner Malleolus and along the inner side of the leg; accompanied by the Internal Saphenous nerve, it continues to ascend until it terminates in the Femoral vein. It receives, in its course, cutaneous tributaries from the leg. It communicates in the foot with the Internal Plantar vein, in the leg with the Posterior Tibial veins, by branches which perforate the Soleus muscle, and also with the Anterior Tibial veins. (See Chart No. 25.)

The External or Short Saphenous Vein commences at the outer side of the Venous arch on the Dorsum of the foot. It ascends behind the outer Malleolus and along the outer border of the Tendo-Achillis, across which it passes at an angle to reach the middle line of the posterior aspect of the leg. It ascends to terminate in the Popliteal vein, and is accompanied by the External Saphenous nerve. It receives numerous large tributaries from the back part of the leg and communicates with the deep veins on the Dorsum of the foot. It also gives off a communicating branch which passes upward and inward to join the Internal Saphenous vein. (See Chart No. 26.) The deep veins are situated too high up in the leg to be of any service in the consideration of the blood supply of the foot; therefore, this concludes the description of all of the veins which will be necessary for our purpose.

CHAPTER XI

THE NERVES OF THE LEG AND FOOT

Under this heading we are to study just those nerves which are in direct relation to the structures of the lower limb alone. The minute description of the structure of a nerve was given under Chapter V. For our convenience we must commence with the uppermost nerve in the leg supplying nerve force to the lower limb and foot. The first one to be considered is the Great Sciatic nerve. It is not necessary to describe the Great Sciatic nerve minutely, as it will suffice to say that this nerve gives off two important branches which supply the muscles of the calf of the leg and foot, namely, the Internal Popliteal and External Popliteal nerves. (See Chart No. 27.)

The Internal Popliteal Nerve.—The larger of the two terminal branches of the Great Sciatic nerve descends along the back part of the thigh to the lower part of the Popliteal muscle, where it becomes the Posterior Tibial nerve and lies in close relation with the blood vessels. This nerve has several branches, namely, the Articular, Muscular, Cutaneous and the External or Short Saphenous nerve.

The Articular Branches, usually three in number, supply the knee joint.

The Muscular Branches, four in number, supply the Gastrocnemius, Plantaris, Soleus and Popliteus muscles.

The Cutaneous supplies the integument.

The External or Short Saphenous descends about the middle of the back of the leg and receives a communicating branch from the External Popliteal nerve. It then continues its course down the leg along the outer margin of the Tendo-Achillis, and is distributed to the integument of the outer side of the foot and little toe. (See Chart No. 28.)

The Posterior Tibial Nerve commences at the lower border of the

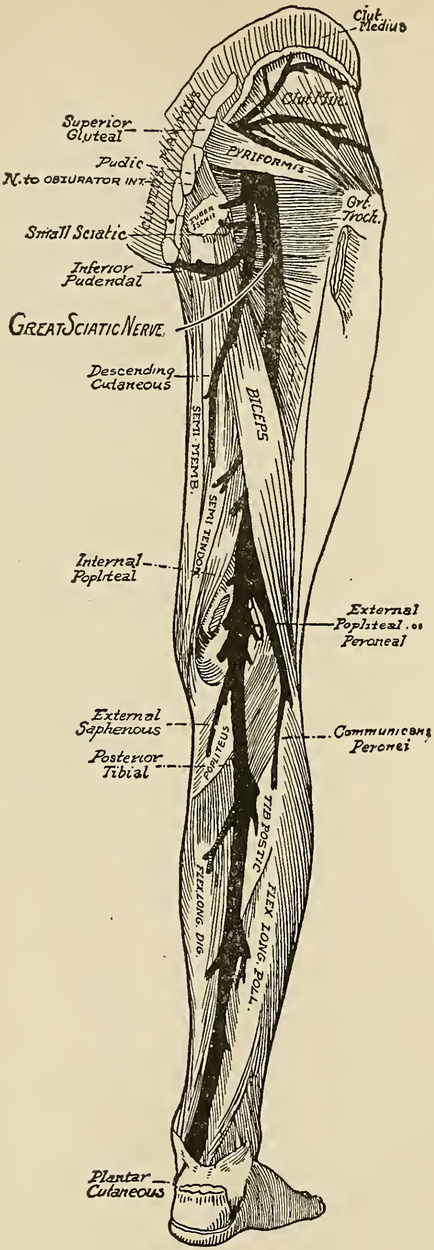


CHART No. 27
Nerves of Leg and Foot.
(Posterior View)

Popliteus muscle and passes along the back part of the leg with the Posterior Tibial vessels to the interval between the Inner Malleolus and the heel, where it divides into the External and Internal Plantar

CHART No. 28
Cutaneous Nerves of the Lower Extremity. (Posterior View)

nerves. Besides these, it sends off three smaller branches, namely, the Muscular, Plantar-Cutaneous and Articular. (See Chart No. 27.) The Muscular branches arise from the upper part of the nerve and supply the Tibialis Posticus, Flexor Longus Digitorum and Flexor

Longus Pollicis muscles. The Plantar-Cutaneous branch perforates the Internal Annular ligament and supplies the integument of the heel and inner side of the sole of the foot. The Articular branch supplies the ankle joint.

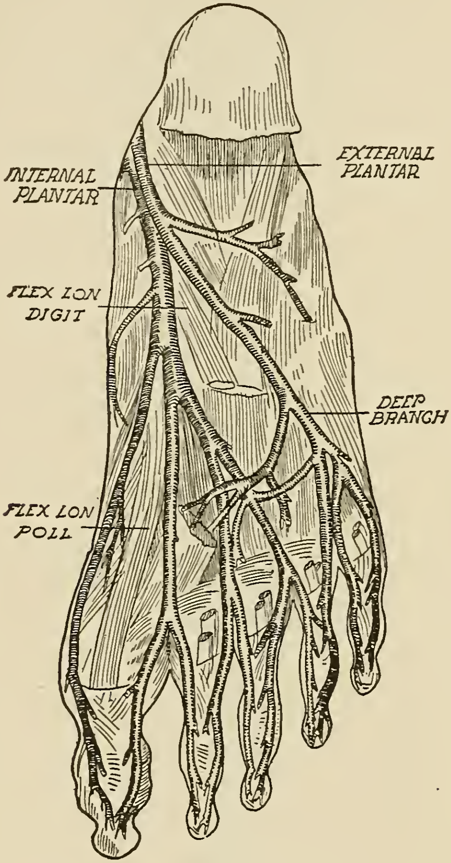


Chart No. 29
The Plantar Nerves.

The Internal Plantar Nerve, the largest of the two terminal branches of the Posterior Tibial nerve, accompanies the Internal Plantar artery along the inner side of the foot. It commences at the ankle, passes forward, dividing at the bases of the Metatarsal bones into four digital branches, and communicates with the External Plantar nerve. (See Chart No. 29.) This nerve gives off cutaneous branches which supply the integument of the sole of the foot; muscular branches which supply the Abductor Pollicis and Flexor Brevis Digitorum muscles; articular branches to the articulations of the Tarsus and Metatarsus, and four digital branches which pass between the toes and are distributed as follows: The first supplies the inner border of the great toe; the second bifurcates to supply the adjacent sides of the great and second toes; the third supplies the adjacent sides of the second and third toes, and the fourth supplies the corresponding sides of the third and fourth toes.

The External Plantar Nerve, the smaller of the two terminal branches of the Posterior Tibial nerve, completes the nervous supply to the structures of the foot, being distributed to the little toe and one-half of the fourth toe, as well as to most of the deep muscles. It passes obliquely outward to the outer side of the foot, lying between the Flexor Brevis Digitorum and Flexor Accessorius, and divides into a superficial and deep branch supplying the Flexor Accessorius and Abductor Minimi Digiti muscles.

The Superficial Branch separates into two Digital nerves. One supplies the outer side of the little toe, the Flexor Brevis Minimi Digiti, and the two Interosseous muscles of the fourth Metatarsal space, the other digital branch supplying the adjoining sides of the fourth and fifth toes, and communicates with the Plantar nerve.

The Deep or Muscular Branch accompanies the External Plantar artery into the deep part of the sole of the foot and supplies all the Interosseous muscles (except those in the fourth Metatarsal space), the two outer Lumbricales, the Adductor Pollicis and the Transversus Pedis. (See Chart No. 29.)

The External Popliteal or Peroneal Nerve is situated about the Popliteal space in the back of the leg, descends to the Peroneus Longus muscle, where it divides into the Anterior Tibial and Musculo-Cutaneous nerves. (See Chart No. 27.) The branches of the External Popliteal nerve before its division are the Articular and Cutaneous branches, which supply the knee joint and the integument in that region.

The Anterior Tibial Nerve commences at the bifurcation of the Peroneal nerve, passes forward and then descends to the front of the ankle joint, where it divides into an external and internal branch.

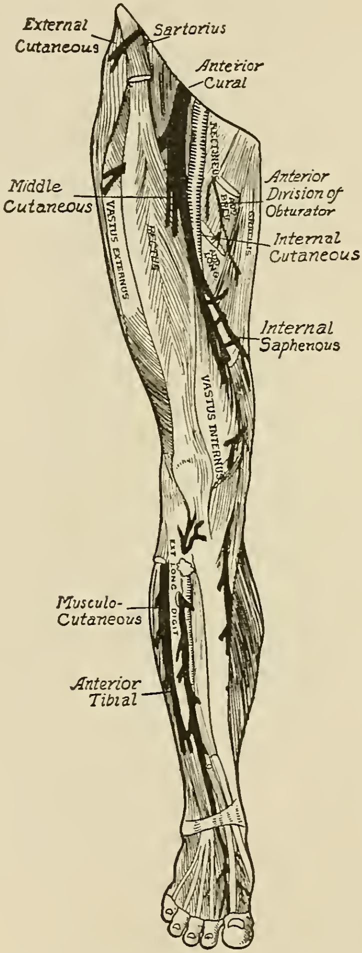


CHART No. 30
Nerves of the Leg and Foot.

(See Chart No. 30.) The branches of the Anterior Tibial, in its course through the leg, are the muscular nerves to the Tibialis Anticus, Extensor Longus Digitorum, Peroneus Tertius and Extensor Proprius Pollicis muscles, and an articular branch to the ankle joint.

The External or Tarsal Branch passes outward across the Tarsus and supplies the Extensor Brevis Digitorum and the articulations of the Tarsus and Metatarsus.

The Internal Branch is a continuation of the Anterior Tibial nerve. It accompanies the Dorsalis Pedis artery along the inner side of the Dorsum of the foot and, at the first Interosseous space, divides into two branches, which supply the adjacent sides of the great and second toes, communicating with the internal division of the Musculo-Cutaneous nerve.

The Musculo-Cutaneous Nerve supplies the muscles on the Fibular side of the leg and the integument of the Dorsum of the foot. It passes forward and at the lower third of the leg it divides into two branches. In its course it gives off muscular branches to the Peroneus Longus and Brevis and Cutaneous filaments to the integument of the lower part of the leg. (See Chart No. 30.)

The Internal Branch passes in front of the ankle joint along the Dorsum of the foot, supplying the inner side of the great toe and the adjoining sides of the second and third toes, also supplying the integument of the inner ankle, and inner side of the foot, communicating with the Internal Saphenous nerve, and joins with the Anterior Tibial nerve between the great and second toe.

The External Branch passes along the outer side of the Dorsum of the foot, to be distributed to the adjoining sides of the third, fourth and fifth toes, also supplying the integument of the outer ankle and outer side of the foot, communicating with the Short Saphenous nerve.

From the foregoing description of the nerves, it will be seen that every structure of the leg and foot is supplied with a number of nerves which are intimately related to these structures, and any malformation of the foot may cause pressure on these nerves, resulting in severe pain. Thus it is important that you have a knowledge of the nerves described in this chapter.

CHAPTER XII

THE SKIN AND NAILS

Under this chapter we will consider the outermost structures of the foot, namely, the Skin and Nails, and also give a resumé of the entire anatomy of the leg and foot in general.

THE SKIN

The skin may be regarded as a covering for the protection of the deeper tissues; it is also an important excretory and absorbing organ. It is the principal seat of the sense of touch and the chief factor in the regulation of the body temperature. It consists principally of a layer of vascular tissue named the Derma, or Corium (true skin), and an external covering of epithelial cells, termed the Epidermis or Cuticle. On the inner layer are found the Sweat Glands, Hair Follicles and Sebaceous Glands. (See Chart No. 31.)

The Epidermis, or Cuticle, is an Epithelial structure forming the defensive covering to the true skin, and varies in thickness in different parts. In the soles of the feet it is thick, hard and horny in texture, as these parts are exposed to intermittent pressure, while on the Dorsum of the foot this layer is much thinner and exceedingly fine in texture. The deep surface of the Epidermis is accurately molded upon the Derma.

The superficial layer of cells of the Epidermis, called the horny layer (Stratum Corneum), is the layer most frequently involved in corns and callouses when subjected to pressure and friction.

The Derma is a tough, flexible and highly elastic structure for the purpose of protecting the parts beneath from violence, and consists of fibrous connective tissues with a large admixture of elastic fibers, blood vessels and nerves.

APPENDAGES OF THE SKIN

The Hair.—Hair is found on every part of the surface of the body except the palms of the hands and the soles of the feet. A hair consists of a root, the part implanted in the skin; the shaft or stem, the portion projecting from the surface of the skin.

The root at its extremity is bulbous and is lodged in an involution of epidermis called the hair follicle.

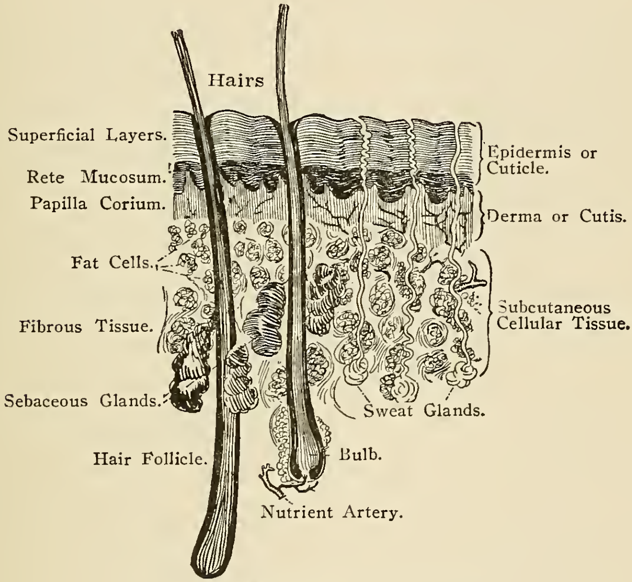


CHART No. 31
Sectional View of the Skin (Magnified).

Sebaceous Glands are small sacculated glandular organs lodged in the substance of the Corium. They are found in most parts of the skin, but are wanting in the palms of the hands and the soles of the feet. The orifices of the ducts open most frequently into the hair follicles.

The Sweat Glands or Sudoriferous Glands are the organs by which a large portion of the aqueous and gaseous materials is excreted by the skin. They are situated in the Corium and subcutaneous areolar tissue surrounded by adipose tissue. They are small, lobular, reddish bodies consisting of a single convoluted tube from which the efferent duct proceeds upward through the Corium and Cuticle, becomes dilated and opens on the surface of the Cuticle by an oblique valve-like aperture called a pore.

The size of the glands varies and they are most numerous in the palms of the hands and the soles of the feet.

THE NAILS

The nails are flattened, horny structures placed upon the terminal phalanges of the toes. Each nail is implanted by a portion, called the Root, into a groove in the skin, the exposed portion being called the Body, and the anterior extremity the Free Edge. The nail has a firm adhesion to the cutis, being accurately molded upon its surface. The part of the cutis beneath the body and root of the nail is called the Matrix, because it is the part from which the nail is produced. The nails protect the terminal ends of the toes, and are subject to many malformations due to the pressure they receive from shoes, etc.

GENERAL REVIEW

This concludes the description of all the soft parts of the leg and foot. I will now give you a basis upon which you may distinguish and clearly understand how the various malformations occur.

Let us now look over the foregoing pages and review in general the anatomy of the leg and foot. First the bones of the leg and foot were described as they make up the framework of these parts, then the ligaments were considered, being the structures which keep the bones in their position; after that the muscles and tendons were fully described, as they are the structures which produce movement of the different bones. Then the blood vessels, such as arteries and veins, were described, as it is their function to supply these structures with nourishment and, ultimately, the nerves and the outer covering of these parts; thus giving you a detailed description of the leg and foot.

CHAPTER XIII

COMPARATIVE ANATOMY

The purpose of this chapter is to compare the foot with the hand, the foot being the distal member of the lower extremity, while the hand is the distal member of the upper. By such a comparison we obtain the most valuable aid in the comprehension of its structure. It has been stated on several occasions that the foot is merely a hand altered by the functions of support and locomotion which it is obliged to perform.

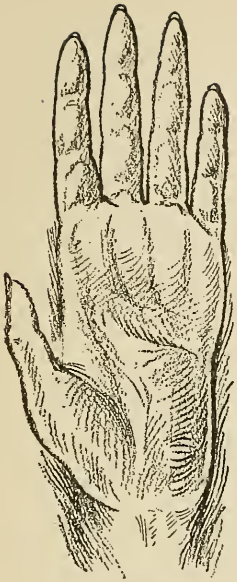
While it is generally true that the feet and hands are constructed upon similar plans, it must be remembered that the differentiation evolves from the animal series.

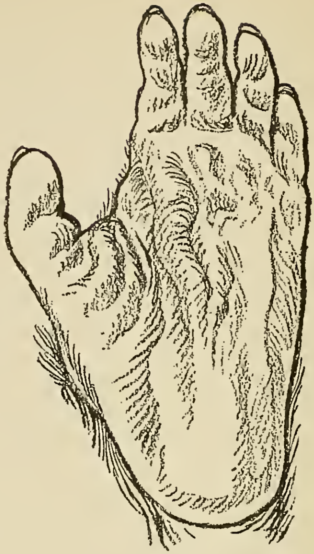
The similarity of the anterior and posterior extremities of a quadruped, such as the horse, for instance, disappears to a considerable extent when the anatomical structure is minutely examined. Also, in quadrupedal locomotion the posterior extremities are the ones most active in propelling the body, the anterior limbs being chiefly for support and equipoise.

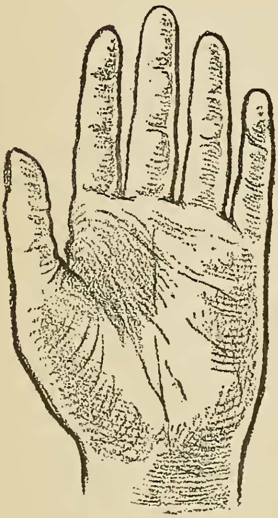
The impression of the fore feet of an unshod horse is different from that of the hind feet, due to the fact that, as the fore limbs come to be more used for the purpose of prehension and dexterity, the difference in structure is more pronounced.

The higher apes were improperly called quadrumana; for no animal, zoologically speaking, has four feet anatomically similar; nor has any animal four organs that can be called hands. The differences are various according to the adaptation of the anterior and posterior members for the special activities of the animal.

The bones of the Carpus are never found to be the same as those of the Tarsus, varying either in number or in the union of the various osseous elements. There is not, properly speaking, any


Chimpanzee's Hand.


Chimpanzee's Foot.


Human Hand.

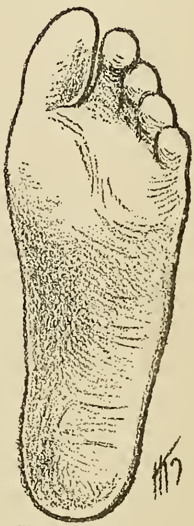

Human Foot.

CHART No. 33
Comparing the Human Hand and Foot with the Chimpanzee's.

opposability of the great toe in apes, as it cannot be carried around and placed at will against the various other toes; but is set at a wider angle than the others in order that it may be used like the curve of a pincers, or of a cramp-iron, for grasping and climbing. The posterior extremities of apes are merely feet adapted for walking upon trees, the resemblance of the foot or "hind-hand" to a true hand being only skin deep.

There appears from the structure of the human foot no reason to doubt that it has been developed from an organ adapted for the same use. Strong evidence of this is found in the fetal condition of the foot, which approaches in many respects that of the Anthropoid apes, there being less development of the heel, an arrangement of the joints which permits more inversion of the sole, and a difference in the corresponding length of the first and second Metatarsal bones, indicating that the adult condition in which the great toe is as long or longer than the others has been gradually acquired.

Chart No. 33 shows the hand and foot of the chimpanzee contrasted with the same members in the adult man. In the gorilla the resemblance to the human hand and foot is still greater.

The feet of a child that has never walked show decided differences in power of using the toes, there being considerable grasp and the same imperfect opposability of the great toe as is seen in the apes.

The markings on the foot of a child that has never worn a shoe, nor stood alone upon its feet, resemble somewhat those of the palm of the hand, indicating considerable freedom of flexion and a certain amount of independent use of the great toe.

They almost entirely disappear after the foot is used as a support. The power of the great toe may, however, be kept up if the feet are not confined, and many savage tribes use the feet for grasping.

Among Australian savages this grasping power is of great assistance in climbing trees, and they habitually pick up a spear or similar object with the foot. Nubian horsemen are said to use the reins, and Chinese boatmen to pull an oar, by means of the great toe. Occasionally persons may be found who are either born without hands, or losing them early in life, have acquired the habit of using the foot for various acts ordinarily performed by the hands, and can thread a needle (as the Hindoo tailors), use scissors, or even write with the toes. The fact that walking in the erect position is learned only with difficulty shows that it is a late acquirement.

The main characteristics of the human foot are, therefore, those which adapt it for support and locomotion. For this purpose a most beautiful structural arrangement has been effected, combining great strength with peculiar elasticity and lightness. The bones are set in the form of a vault, supported at the points connected by arches, two of these starting from the same point of the heel (the Tuberosity of the Os Calcis) and extending forward, one to the ball of the great toe (head of first Metatarsal), the other to a corresponding point on the little toe. These arches are known as the Inner and Outer Longitudinal. The third arch is transverse, connecting the anterior ends of the longitudinal ones. (See Charts of Arches in Chapter IV.)

The Inner Longitudinal arch is formed by the Os Calcis behind the first, second and third Metatarsal bones, the Cuneiform and Scaphoid bones in front, with the Astragalus set at the vertex as a keystone.

The Outer Longitudinal arch, which is nearly flat, is formed by the Os Calcis, Cuboid, and two outer Metatarsal bones, which articulate with it.

The transverse arch is formed behind by the three Cuneiform bones and the Cuboid, in front by the Metatarsal bones. It should be noted that the curvature of the arch diminishes as the toes are approached until it reaches the heads of the Metatarsal bones, the weight being fully upon them all. The imprint of a normal human foot shows this clearly.

The height of the arches forms the instep, a feature peculiar to man, and which varies considerably in different races, being generally higher in the Indo-European than in others. Arabs are said to boast that their insteps are so high that water will run under them without wetting the sole. The Andalusian instep is said to be famous. A popular saying has it that the foot of the negro is so flat that it makes a hole in the ground. A very amusing proof of this primitive condition of the negro foot may be noticed in Southern cities where, during the heat of summer, it is customary to wet the pavements in the evening. It is not unusual to see barefooted negro boys whose feet are so flat that atmospheric pressure makes them adhere slightly when applied to the wet and smooth pavement, in the same way that a boy's leather sucker adheres to a smooth stone, and it is a favorite pastime with such gifted individuals to walk the streets producing a somewhat startling report every time the foot is withdrawn from the pavement.

It is, perhaps, not without some reason that the height of the instep is considered a mark of aristocracy, as it appears to be one of the signs of complete adaptation to the erect posture and to locomotion in that position.

Man is the only animal that has the feet placed at right angles to the axis of the body, most mammalia not touching the ground with the Os Calcis at all.

The horse, for instance, literally walks upon the points of the toes, the hoof being comparable with the nails of the human foot, and the hock or "knee" being the tuberosity of the Os Calcis. There appears to be some relation between this ascension of the Os Calcis and the fleetness of the animal, as those who are the most rapid have the bones so arranged that they walk merely upon the tips.

If support alone were needed there would be no necessity for the Metatarsal bones and toes, as may be seen in those who have had them amputated. The anterior part of the arch is therefore for purposes of locomotion, and it may be noted that in running the heel is raised off the ground and the anterior part only is used, the anatomical relation of the bones to the ground being similar to that which occurs ordinarily in the foot of the hoofed animals. The great swiftness and lightness of motion of a dancer is owing to her ability to dispense entirely with the posterior portion of the arch.

Owing to this difference of formation the anterior and posterior pillars of the longitudinal arches differ—the posterior, being for support, is short, thick and strong, being of but one bone; the anterior, composed of several bones, is longer, so that the motion of raising the heel can be quickly performed. The apparent length of the heel in the African race is caused by the flattening of the arch rather than by a real projection.

Long heels are characteristic among any sufferers of flat-foot or broken down arch when the posterior portion is mostly involved, the Os Calcis is forced downward and backward and unless the weakened condition is corrected.

The number of bones in the anterior arch greatly aids in the distribution of the force, as one may see who will take the trouble to note the difference "in shock" which occurs when alighting upon the heels rather than upon the balls of the toes. We will now proceed to consider the complete structure of the foot as a whole, including its physiology and mechanical principles.

CHAPTER XIV

PHYSIOLOGY

The human body is composed of different parts which are called organs. Although each organ has its own special work to perform, it also acts in harmony with the other organs. Thus this relationship which exists between the organs enables us to group them into separate bodies, which are termed "systems," namely, the Circulatory system, including the heart, arteries, veins, etc., conveying the blood to different parts of the body; Respiratory system, including air passages, lungs, etc., which are concerned in the act of breathing; the Digestive system, which deals with the digestion of food; the Excretory system, which rids the body of its waste products; the Muscular system, with movement, and the Skeletal system, with the support of the softer parts; the Nervous system, including the brain, spinal cord and nerves, is the greater master system of the body, which controls and regulates the functions of the other systems.

THE FUNCTIONS OF THE FOOT

In its natural state, the human foot presents an example of the most perfect mechanism connected with the human frame. The framework of the foot is composed of twenty-six bones: the seven bones in the Tarsus, and the five in the Metatarsus, which unite to form the arch and give elasticity by yielding to pressure, and the fourteen bones which form the toes or phalanges.

All of the fundamental tissues of the body enter into its complex parts, such as the ligaments, composed of fibrous inelastic bands which unite the bones at the points of articulation; the strata of muscles arranged next to the bones which, by their contraction and relaxation, produce motion and locomotion, enabling the foot to bear the weight of the body; the nerves, extending in various branches from the brain and spinal cord, through which messages are conveyed to the mind, knowledge of substances with which the foot comes in contact, and through which the power of the will is exercised upon the muscles, causing them to contract; the blood vessels which convey the blood to the different parts, nourishing and promoting their growth; the synovial membranes and bursae sac or capsules, which secrete a viscid liquid, lubricating the joints, preserving their normal state; the cellular and fatty tissues, which serve to cushion, giving the foot the perfect symmetry and artistic beauty with which all are familiar, and the skin and its appendages, which conform to, cover and protect the delicate structures beneath, and which contain nerves, veins, arteries, secretory and excretory glands, in direct relationship with all parts of the body system.

When you realize the complexity of the structures, the completeness of every form of tissue involved in the physiological construction of the human foot, it is then clear what an important part of the body this is.

MOVEMENTS

The various kinds of movements which the foot is capable of performing are known as Flexion and Extension, Abduction and Adduction, Inversion and Eversion:

Abduction of the Foot.—Is the act of drawing the foot away from the center or median line, when acted upon by the abductor muscles. (Fig. 2, Chart No. 35.)

Adduction of the Foot.—Is the drawing of the foot towards the center or median line of the body, when acted upon by the adductor muscles. (Fig. 1, Chart No. 35.)

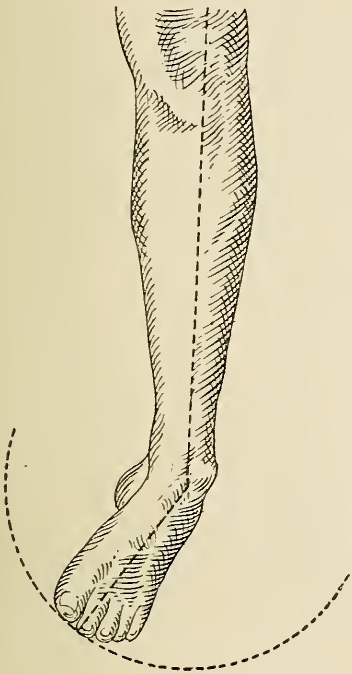
Flexion of the Foot.—Is the act of bending the joints when acted upon by the Flexor muscles.

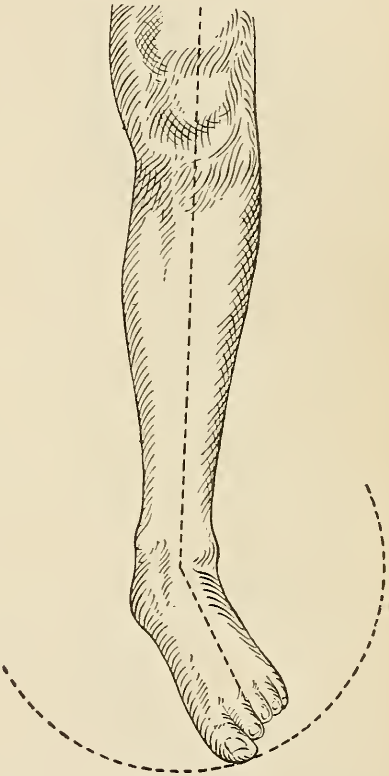
Extension of the Foot.—Is the stretching of the foot when acted upon by the Extensor muscles.

Inversion of the Foot.—Is the inward turning of the foot.

Eversion of the Foot.—Is the outward turning of the foot.

The movements of Flexion and Extension are most marked at the ankle joint, and are known as Plantar and Dorsal Flexion, respectively. With the foot upon the ground the leg can be flexed on the foot until it forms an angle of approximately seventy to seventy-five degrees with the sole of the foot. When Dorsal Flexion is limited, as when the Tibia can be flexed only to a right angle, an abnormal condition exists, and the proper functioning of the foot is interrupted.





Voluntary Adduction. CHART NO. 34 Voluntary Abduction.

Plantar Flexion of the foot is greater, extending to form an angle of about one hundred and fifty degrees with the leg, because of the convexity of the outer border of the pulley-like process, or Trochlear of the Astragalus. The interior portion of that bone is turned slightly inward when in full Plantar Flexion, and less markedly outward when in full Dorsal Flexion. This is clearly demonstrated by the outward thrust of the ankle when a person rises on tip-toes, the weight of the body preventing the toes being çarried inward and, therefore, as Plantar Flexion progresses the ankle is forced outward. It can thus be seen by the above illustration that Plantar Flexion with Adduction and Dorsal Flexion with slight Abduction is normal at the

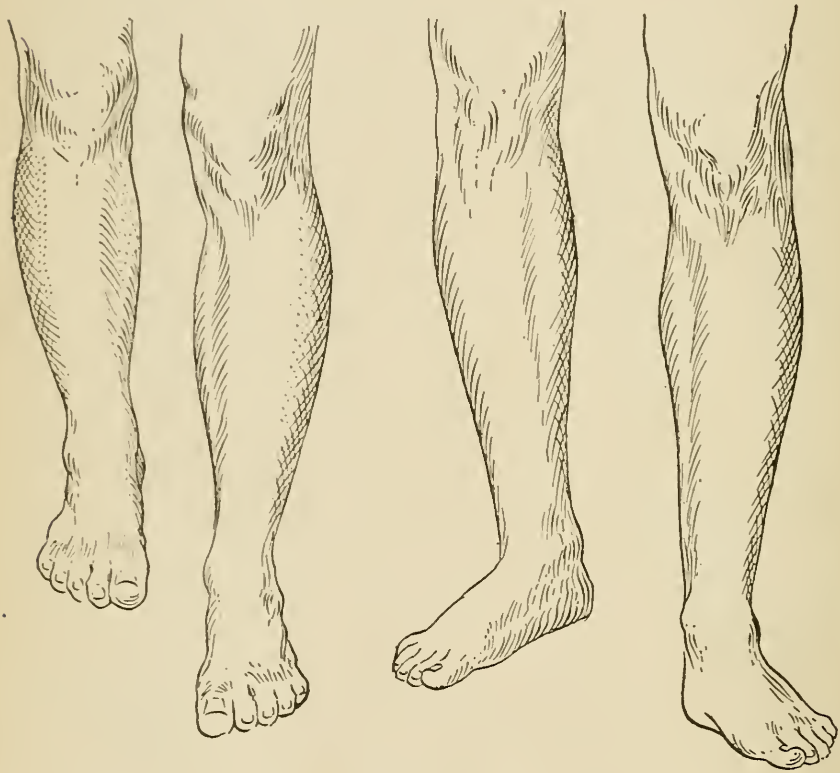


Chart No. 35

Fig. 1. Involuntary Adduction. Fig. 2. Involuntary Abduction.

ankle joint. Inversion and Eversion, in which the sole is drawn inward or towards the center and outward or away from the center, are the chief movements at the Sub-Astragaloid joint. With Eversion and Inversion there is also some Adduction and Abduction and rotation about a vertical axis.

The Astragalo-Scaphoid and the Calcaneo-Cuboid joints are usually spoken of as one, and called the Medio-Tarsal joint. The movement at this joint is about a vertical axis in the direction of Abduction and Adduction; also rotation on an Anterio-Posterior axis, and movement on a Transverse axis, producing flexion and extension.

The Arthrodial joints, which are anterior to the Medio-Tarsal joint, have only slight movements, but are necessary in the normal use of the foot. Any abnormality of the Metatarso-Phalangeal joints, especially the first, may occasion serious loss of function of those joints.

From the above the student will see that there are three principal axes of movement in the foot, namely, (a) Transverse, through the lower part of the Astragalus, in which the movements are chiefly extension and flexion; (b) Horizontal, extending anterio-posteriorly

CHART No. 36
Manner of Walking—How Steps Are Made.

through the Sub-Astragaloid joint, where inversion and eversion are the most marked movements; (c) Vertical, through the Medio-Tarsal joint, abduction and adduction of the fore foot being the movements most marked at this point.

The advantage of the construction of the great toe is readily seen when it is learned that by its large size it forms a firm and solid base; and by its division into two phalanges, with two flexor muscles one to each, is effective in holding them down and keeping it straight in all its length. Motion in the first Metatarso-Phalangeal joint is chiefly in a plane downward and inward, away from the other toes and towards the middle line of the body. When at rest the great toe is drawn towards the other toes and slightly dorsal flexed; in action it is never flexed or extended, is in a line with the foot, and abducted. Thus the space noticed between the great and second toes.

CHAPTER XV

MECHANICAL CONSIDERATION OF THE HUMAN FOOT

Under this heading we must have a general review of the complete foot from the external surface. We have a member whose function is to supply means of locomotion to the body—a framework of bone

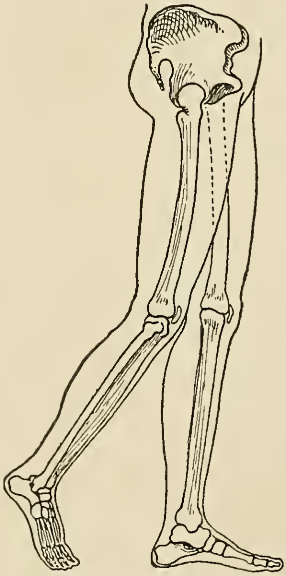


CHART No. 37
Manner of Balance in Walking.

supported by ligaments and muscles, and moved by muscles and their attachments through nerve impulses. With this combination the legs and feet in walking form a combined system of levers that work together. The ground under the feet is a fulcrum to this system. It carries the weight of the body and any burden in addition to it, and when we examine the foot in detail we find almost every bone forms a lever, and every articulation a fulcrum, to the contracting muscles and force.

It is now established that the body's weight and its burden is carried into the foot, that it has a power of movements that propel the body, and it is now necessary to review the inner Longitudinal arch, the shorter or outer Longitudinal and Anterior Transverse arch. (Charts Nos. 36 and 37.)

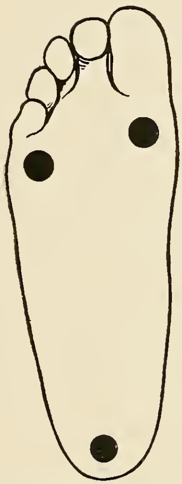


CHART No. 38
Weight Is Carried at the Three Points.

Then the weight carrying points on the foot are the heel and the heads of the first and fifth of the Metatarsals. The movements in walking then may be described as follows: (See Chart No. 38.)

Starting from a standing position, the body in erect attitude, and leading with the right foot, the first thing done is gently to throw the whole weight of the body upon the rear or left foot, and as soon as the right foot is relieved it leads off, the right leg being stretched forward while the foot is being at the same time extended by the contraction of the muscles of the calf of the leg and sole of the foot, so that the sole as it advances remains nearly parallel to the ground.

The right leg and foot being thus extended, the center of gravity is, by the force of other muscles of the body, also gradually thrown forward, while the heel of the left foot by itself, and the contraction of the muscles of the calf of the leg and sole of the foot, is raised from the ground, and the whole weight of the body for a moment of time is being placed upon the base of the left foot; then from this point the weight is thrown forward upon the right foot, and in this manner uniform progression is produced.

The action of the center of gravity thus gradually brought forward from the right foot, the left foot at the same time being raised from the ground, is then moved past the right leg when it is next extended, so that step by step the force and center of gravity moving from foot to foot gives the movements of the foot in walking. As will be seen in the illustration, the heel strikes the ground first, with the toes slightly pointed upward; the ankle joint is held firmly by the muscular groups, the latter yielding as the center of gravity is advanced, and as more an ' more weight is thrown on one foot by propulsion from the other. In the method of walking and stepping lively there is a tendency to involuntary adduction to the fore part of the foot, but where a person walks slowly, lingering along, in order to maintain the equilibrium, the foot assumes an abducted position, and this position is a forerunner to weakened arch and later flat foot, due to the inward and downward rotation. (See Chart No. 39.) Therefore, it can be seen that from a standpoint of flat foot it is less liable to occur in the fast walkers than those persons whose occupation or habits cause them to walk slowly and with the feet in an abducted position. The flexible, graceful movements of the feet in walking are due to the many anatomical points which we have considered in their structure. The Longitudinal and Transverse arches permit of considerable grace and elasticity to the steps, also give a fulcrum, strength and stability without diminishing the graceful, elastic movements. It is also through these many articular points that fracture of the foot is less liable.

There has been much discussion as to the correct manner of walking, whether the heel or toe walking is more correct, but it would appear from the careful study of the feet that as long as the heel reaches the ground at every step, the strong tendons and a soft pad covered with thick skin, makes it better adapted than any other part of the foot for contact with the ground. Perhaps this is not the

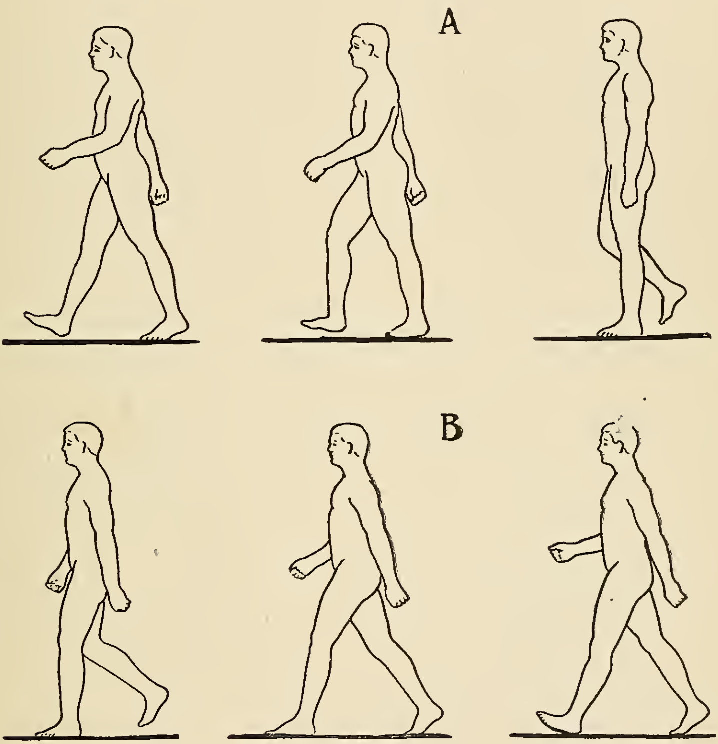


CHART No. 39
Straight Leg Walking (After Bradford).
A—Toe Walking. B—Heel Walking.

reason for believing that the weight of the body is intended to fall upon the heel in walking, but it is admirably adapted for sustaining the weight of the body as it falls and is transmitted to the ground.

When one has taken a long walk, and is quite fatigued, there is a natural desire and tendency to stand with legs spread, relaxing the muscles of the legs, and on doing so the toes are thrown outward, the muscles are relaxed, and the ligaments through their stretching and bracing action relieve the muscular pressure; therefore, it is seen that the ligaments give support to the structures when the body is in a passive state, but ligaments are not adapted for a prolonged strain, and whether it be in walking or prolonged standing they must be relieved, otherwise their tone and strength is lost and flat foot develops.

I have often had the point raised as to whether the well formed feet of the present date should be straight on the inside from heel to toe. It is true that in infancy the point of the great toe projects from the other toes, so that a straight line can be drawn through the center of the great toe and heel, but as the bones form and develop there is an enlargement of the Tarsal bones, increasing of thickness of the foot, owing to its mechanical covering, the shoe, and it gradually assumes a more pointed shape. Whether or not a shoe built over a last to conform to the theoretically normal foot would be practical on the present day type of feet of adults, who for many years have worn pointed shoes, is very doubtful because it would require a re-building or reforming action to the structures, which could only be accomplished by gradual change extending over a long period of time.

The mechanical action of footwear is a deep study and one which requires close observation in each individual case. It is not at all difficult to interest the reader on a subject of this kind who recognizes that upon the foot depends greatly the physical well being of the body. When one considers the anatomy and physiology of the body, he can readily appreciate the close relationship of the feet to the other parts of the body—circulatory and central nervous systems are two of the important parts to be considered.

This can readily be compared with the consequences arising from cold, wet feet, how they cause discomforts in wear and tear to the body, and how when the feet give rise to pain and discomfort one will decrease his daily exercise of walking. A weakened arch, a flat foot, or metatarsalgia, and all of these conditions give rise to bodily discomforts. Nervousness, stomach disorders, pelvic disorders, indigestion, headaches, spinal deformities, drop shoulders, rheumatics, neuralgia, and many other diseased conditions can be directly traced as caused by the feet, and thus one who is making a study of the feet can feel himself a humanitarian by providing relief and correcting any of the various minor foot deformities which can be consistently treated by mechanical means, and any cases which he cannot properly treat should be referred to the physician and surgeon.

CHAPTER XVI

EXAMINATIONS

Believing that some procedure should be followed in making examinations, in order to facilitate diagnosis and diminish the frequency of errors, I have outlined the following:

If in the shoe store, a quick examination can be made without removing the stocking, although for accuracy it is essential that it be removed. There are various ways of detecting foot trouble so as to be able to impress the patient that you are capable for the work.

Inspection.—The patient's legs and feet should be minutely inspected to discern the following abnormal conditions: a limp, abduction of the foot, wearing of the shoe over the Internal Malleolus, prominence of the Inner Malleoli; if the feet are parallel or divergent when the patient stands; if the soles are flat on the ground, or are turned upward; if any of the joints, especially the first and fifth Metatarso-Phalangeal, is prominent through the shoe.

Notice if the inner sole of the shoe is smooth or contains indentations; if the sole is worn through at one point while scarcely touched at another; if the great toe has forced a cavity or opening in the toe of the shoe, because too short. Another positive means without removing the stocking is by palpation over the Dorsum and Plantar surface for any irregularities.

History.—After a thorough inspection has been made the patient should be questioned to obtain a history of the case: information regarding recent illness and injuries; the occupation; customary use of the feet; the amount of dancing and participation in athletic events, and of what nature; how long ago the feet were well, and when the present trouble began; if the patient was ever troubled before, and if entirely recovered; if the complaint is that of weakness, or fatigue, or of pain; if the feet burn; if the pain is continuous or worse at times; if the latter, what appears to influence it; if it is due to use of feet; if so, of what kind and how much; if it is worse in the night or morning; if it affects one or both feet; if one was affected before the other; if they are both affected now. Inquiries of the family or

CHART No. 40
Manner of Examination with Stocking Removed and Testing for Weak Foot Condition.

personal history should be made in order to determine if there is any trace of constitutional diseases, such as tuberculosis, gonorrhea, syphilis or rachitis. As rheumatism and gout play an important part in localized foot troubles, inquiry should be made relative to previous treatment, as this will facilitate in determining what treatment the patient requires.

In making complete examinations both feet and legs above the knee should be bared. Then the shoes should be carefully inspected, locat-

CHART No. 41
Pointing Out Spreading of Foot Between First and Fifth Metatarsal, in which Case the Support is Elevated Between the Two Points.

ing the parts most worn on the soles and heels; noting if the uppers are stretched, consequently overlapping the heels on either side; if the sole on the inner side and heel are on a straight line; the height of the heel should be compared with that of the sole, to note whether there is even pressure at the heel and at the ball of the shoe, and if the center of the heel is under the center of the weight-bearing part of the foot. As stockings are a common evil in causing foot troubles, it should be given due consideration, thus a careful examination of them should also be made. It should be noted if they are damp; if they are pointed; if they constrict the toes, and if so they should be drawn away from the Distal end of the Phalanges. The color of the skin should be observed to determine if the blood supply is faulty. The patient should then be told to stand, and the position of the toes noted: if they are flat on the ground, flexed, hyperextended or parallel;

Chart No. 42
Testing for Flat-Foot.

if there is a hallux valgus; if the fore foot presents a flattened-out appearance; if it is unusually wide; if there is a concavity or a bulging beneath the tuberosity of the Scaphoid. It should be noticed if the Malleoli are well defined, and if the outer one appears to be in its normal relation to the inner one, or is apparently advanced.

EXAMINATION OF THE FOOT

When examined from behind, does the Tendo-Achillis run in a vertical line down to the Os Calcis, or does it deviate to one side; are the depressions on either side of the heel cord normal; and is the heel spread out on all sides? The patient should be asked to rise on his toes, and observed if it is done easily and without exertion. It should be noticed if the dome is heightened, or the ankles are thrown upward and outward; also if the patient can stand on the outer borders and invert the feet.

Chart No. 43
Testing for Mobility in Tarsal Region.

PALPATION

The person making the examination should be seated in a chair lower than the one in which the patient is seated. The foot, if only one is complained of, should then be placed on your knee in such a way that the entire leg is relaxed and in a comfortable position. By feeling it will be noticed whether the local temperature is normal. The foot should then be examined carefully for evidences of friction or uneven pressure, such as corns and callouses; if there are any callosities present under the fore foot and are they beneath each one of the five Metatarsals or beneath only the middle three; if there is a callous formation along the outer border of the foot, or around the margin of the heel; if there is a bunion over the first Metatarso-Pha-

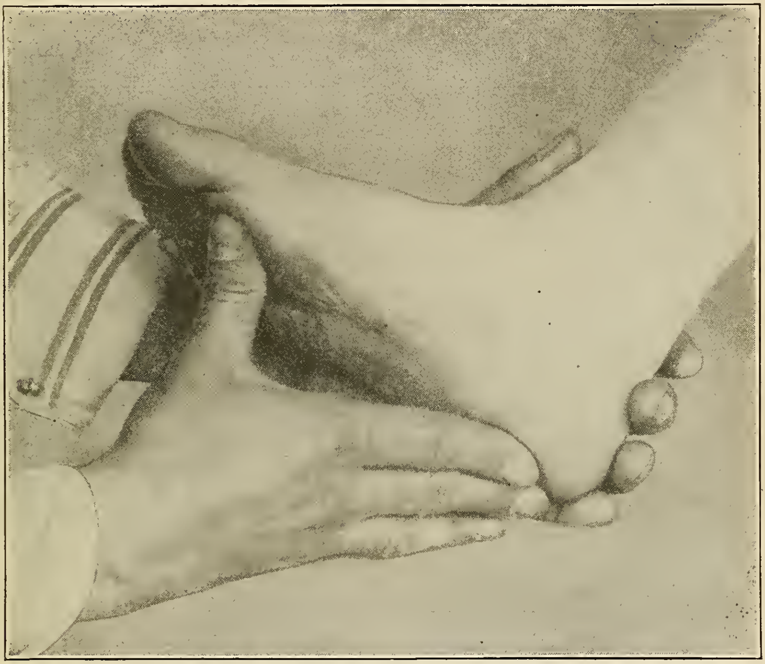


Chart No. 44
Examination Shows Weak Foot.

langeal joint, and also for ingrown toe-nails; the condition of the circulation of the foot. In a normal foot the lower posterior angle of the Internal Malleolus and the inferior external tuberosity at the head of the first Metatarsal should present a straight line connecting the two points with the tuberosity of the Scaphoid slightly above;

also the Tarso-Metatarsal joint of the first toe is normally at middistance of the inner border of the foot, and if upon measuring it shows a lengthening of the posterior half it indicates a lowering of the arch.

If the toes are deformed they can be straightened by passive movements. The motion at the Medio-Tarsal joint can be ascertained if the Os Calcis is firmly held in one hand, with the tuberosity resting in the palm, and grasping the bone with the thumb and fingers

Chart No. 45
Showing How Test is Made for Adhesions About the Medio-Tarsal Joint in Cases of Flat-Foot.

to arrest its movement, then with the other hand the motion can be felt by manipulating the foot. Inversion and eversion can also be tested by holding the leg firmly above the ankle with one hand and with the other grasping the Medio-Tarsal joint, manipulating the foot as above.

Next the ankle joint should be tested, and in order not to be misled by flexion and extension at the Medio-Tarsal joint, the foot should be firmly held, so that the Os Calcis moves at the same time with the Metatarsals. The foot should then be moved in a plane vertical with that of the leg; otherwise abduction in Dorsal flexion will exaggerate the true angle of flexion. With the foot in a position of rest, the range of active movement of all the joints can be determined.

PAIN

Although pain is not of essential importance in making a diagnosis of a normal or diseased foot, it aids materially in making a differential diagnosis. Therefore painful spots should be definitely located. Pain that is caused by pressure over diseased or injured bone is usually more clearly defined and more readily located than the pain

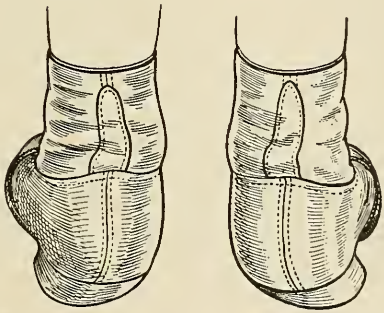


Chart No. 46
Heels Worn Down on Inside Indicate Weak Foot.

from pressure on a strained or ruptured muscle or ligament. Muscles and ligaments that are strained or ruptured are always painful if stretched, and in a ligament pain is produced only by separating the ends; but contraction will produce it in a muscle. When there is pain upon pressure over the body of the Os Calcis it is usually due to disease or injury to those bones. Pain over the Peroneal Tubercle on the external surface of the Os Calcis is due to tension of the synovial sheath of the Peroneal tendon dragging it away from its attachments to this tubercle. In cases of everted feet the pain about the External Malleolus is due to a crowding of the tissues against the External Malleolus from malposition of the Tarsus. Inflammation or strain of the Medio-Tarsal joint may produce pain about the inner side of it. Depressed Metatarsals in cases of Morton's Toe or Metatarsalgia, where pressure of walking has caused irritation, are painful to the touch and each one should be examined by pressure.

CHAPTER XVII

WEAKENED FOOT

Under this heading I will endeavor to point out for the practitioner of mechanical orthopedics certain varieties of flat-foot conditions which I have found to be most prevalent, and I will commence by pointing out the weakened foot type of feet.

CHART No. 47
Weak Foot, Although when Weight is off Foot Appears Normal.

Weak foot consists of only a slight change in the structures when weight is placed upon the foot, and this condition is due to ligamentous causes. There is an abnormal laxity of the ligaments, which permits the weight as it is thrust into the foot to depress the Longitudinal arch and to cause a slight abduction of the foot, and while the feet controlled by the muscles and connecting tendons are apparently normal, they are not afforded the protection against strain for which the ligaments provide when they are normal. Weakened foot is characterized by pain and sensitiveness through the heel and ankle and Internal Malleolus. There is a burning sensation on the sole, and the patient complains of the toes feeling cramped, of swelling through the ankle, aches in the calves, general fatigue and bodily weariness after much standing or walking.

Chart No. 48
Testing for Weak Foot.

When a patient stands, the foot has a tendency to abduction, and slight pronation is present. There may be an extreme tendency towards weak ankles. The patient may complain more of weak ankle than of the pains. Walking is dispensed with as much as possible, and a constant fear of stepping on pebbles or over cobblestones is always present. Shoes are soon thrown out of shape, owing to the spreading tendency of the structures.

This acute weakened foot condition is found among men, women and children, and especially pronounced among growing children between the ages of eight and fourteen. This condition is very infrequently discovered by the patient before the latter stage of flattened foot develops. When weight is taken off the feet the Longitudinal arch assumes a practically normal position. When weight is placed upon the feet the degree of flattening varies considerably, depending upon

Chart No. 49
Correcting with Foot-Eazer Which Should be Fitted to Contour of Arch.

the severity of the weakened condition of the Longitudinal arch. In some cases the arch sinks considerably. In others there is only a slight sinking in the posterior region. Again there is a marked rotation of the foot at the Astragalo-Scaphoid region.

Weak foot is found very common the present day among both sexes of all ages and classes. Those who have made radical and frequent changes in height of heels are more susceptible, due to the ligamentous strain, but an immediate change in the height of the heel is to be avoided.

Weak feet of this type are found among men and women and growing children. When weight is removed from the foot it is apparently normal, but when the patient suffering from weak foot places his body's weight on the foot a slight elongation and forward rotation takes place.

Women who wear extremely high heeled shoes, and who do constant standing or walking, are more prone to this disorder. If mechanical treatment is resorted to at once, permanent correction can be accomplished by means of an arch support. The arch support should be very carefully fitted so as to correct the displacement and weakness, and to hold the foot in a normal attitude. In this way ligamentous strain is immediately removed and the muscles given their full range of motion. Care should be taken to see that the shoe worn by a patient is of sufficient length and width.

Treatment.—The treatment of the weakened foot condition is principally mechanical. In the early and incipient stages pads of felt or leather may give relief, but are objectionable, as they depend upon the shank of the shoe for their base of support. It is very rare indeed that the shank of a shoe will provide strength enough to support the padding intended to hold up the weakened arch. I have obtained best results with the foot-eazer type of support, which is light, resilient and easily adjusted to accommodate the weakened foot and restore and permanently hold the structures until the ligaments have assumed their natural strength and tone. For weakened foot condition the foot-eazer or arch support must be fitted with the foot held in its normal relaxed state so as to hold the foot structures permanently in their natural position. Relief is usually immediate, and cure is effected in three to five months' time. Low-cut shoes are to be advised against if ankles appear weak, although if they are worn the arch supports must be used at all times. Massage and tip-toe exercises are recommended as an auxiliary treatment.

WEAK FLEXIBLE FOOT

Of the many disturbances in structural and weak conditions of the foot one of the most numerous may be classified under the above heading. The symptoms of pain and distress are practically the same as weakened foot or flat foot, although the change in contour of the arch is only apparent when weight is placed upon the foot. In a

CHART No. 50
Weak, Flexible, High Arched Foot.

relaxed condition the shape of the foot is normal, the Longitudinal arch being high, and is usually found among persons who have been accustomed to wearing moderately high heels. The position of the Tarsus is rather contracted to admit of the positioning of the height of the heel. This gives the Longitudinal arch a higher curvature.

The peculiar arrangement of the bones of the foot that make up the arch where the weight is carried and the adjustment of the structures to the poise of the foot with weight upon it necessarily produce extreme pressure to the Anterior Transverse arch. In weakness of the Longitudinal arch added pressure and weight are thrown forward and upon the Anterior arch.

Symptoms.—The foot is usually soft and flexible. By grasping the Os Calcis with the left hand and producing pressure upon the Anterior Plantar surface the foot elongates and assumes a flattened position. There is usually a complaint of weak ankles, fatigue, pain and tenderness in the heel, frequent cramping of the calf muscles, and a sensation of discomfort about the toes as though the shoe had insufficient length. There is a burning sensation to the sole or ball of the foot and a general sensation of discomfort due to swelling through the ankle or dorsum of the foot. Again there will be no swelling or localized pain present. Many persons thus afflicted are not aware of the structural weakness, due principally to the fact that the foot bears no appearance of abnormality.

Chart No. 51
Fitting Foot-Eazer to Weak Foot, Arching it to Give Correction When Walking.

Treatment.—In all cases of weak flexible foot the first essential is to restore and maintain the natural balance of the body's weight as transmitted into the foot. This is accomplished by fitting arch supports to the patient's feet, being particular to make adjustment high enough to fit the inner longitudinal border, creating only normal pressure sufficient to maintain the natural positions of the bone structures. The support should be arched from a point commencing at the external Cuneiform inward and upward to the inner border of the arch, touching the anterior point of the Os Calcis, the lower facet of the Astragalus, Scaphoid, and the inner and middle Cuneiform. In doing so ligamentous strain is removed, muscular activity increased and normal action replaced. For this condition I use the tri-spring arch support, or foot-eazer, which must be carefully fitted

CHART NO. 52
Pointing Out How Weight is Thrown Upon First Metatarsal Joint Owing to Weakness of Longitudinal Arch.

to hold the heel of the foot well back in the heel of shoe and thereby prevent spreading and elongating.

In these feet are also found a weakened condition in the Anterior arch, due probably to the extra pressure imposed upon that portion of the foot. Care should be taken to learn whether or not there is any slight displacement in the Anterior arch, and if found an Anterior Metatarsal arch support should be fitted. The style of shoe worn by the patient, as regards heel height, should not be changed, although care should be taken in advising a shoe of sufficient length and width, with snug fit through the heel and waist.

ACUTE WEAKENED FEET

Characterized by pains and sensitiveness through the dorsum of the foot, same occurring through the heel and ankle and at the External Malleolus. In these cases strips of zinc oxide adhesive plaster, and a small felt pad firmly strapped up in the highest point of the arch to serve as a temporary support, should be used in the beginning of treatment. After a short time a light weight arch support properly fitted should be applied. In any condition of weakened foot, especially those feet poised with a contracted or shortened heel, care must be taken to advise the patient not to change the type of heel previously worn. The shoes are to be fitted closely through the heel and waist to afford snug fit and aid in supporting the weakened foot.

CHAPTER XVIII

FLAT-FOOT—BROKEN-DOWN ARCH

The above subject is also known as valgus, splay-foot, pes valgus, pes planus, talipes valgus. This subject must be of intense interest to the student and practitioner alike, as full use and restoration of these most useful members, the feet, depend upon the proper diagnosing, ex-

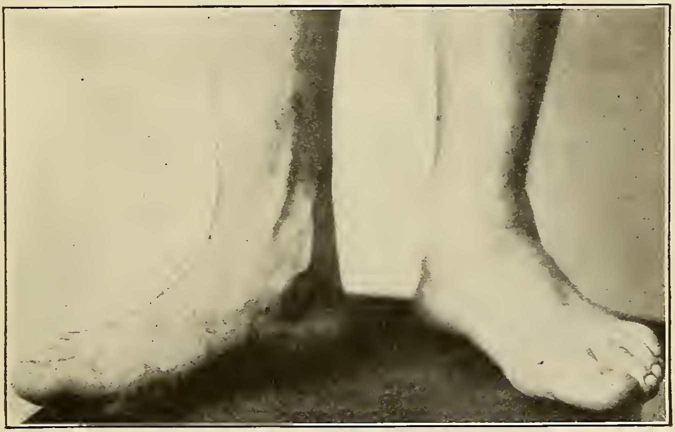


Chart No. 53
First Condition of Flat Foot, Showing the Weakened Condition.

amination and treatment. It is a condition so commonly found among all ages, all classes and both sexes that there should be a constant watch for the recognition of the deformity. The flexibility, the gracefulness and the general health of the physical body depend greatly upon the watchfulness and care in the proper handling of these cases.

Flat-foot would indicate from the description of the term, as generally used, a flattening of the arch or sole of the foot with all the pains and discomfort due to a broken-down arch, strain or abnormal condition, which would be diagnosed as flat-foot, but many are unable to recognize it on account of the misleading descriptive phrase and medical term generally used. Under this heading, however, we would define weak, broken-down arch, flat-foot, talipes valgus, etc., as a condition where the natural arch of the Plantar surface is interfered with, and in some instances partially or entirely lost, and with the foot usually everted and abducted at the Medio-Tarsal and Sub-Astragaloid

Chart No. 54
Acquired Flat Foot in Second Stage.

joints. When we consider again the anatomy of the foot, and mechanical construction of the foot, and that the function of the foot is as a lever to raise and propel the body, and that this body's weight must be maintained by its particular fulcrum, it can be more easily understood why the deformity is so prevalent.

Let us, therefore, review the construction of the Longitudinal arch, or the inner and outer Longitudinal arch, or where the weight is carried into the foot, and remember that the bones of the foot are given their principal support by the ligaments and are only controlled by the muscles and their attachments. It should then be evident that if the structure is insufficiently supported by the ligaments, the muscular power must be insufficient and the weight of the body cannot be carried and properly balanced by the foot. In flat-foot cases the ligaments, generally on the inner and plantar surfaces of the bones, become strained and stretched, allowing the joint surfaces to separate at the bottom while at the top they are forced together.

Flat-foot can be divided into four distinct conditions:

First, the weakened foot just described.
Second, the acquired flat-foot.
Third, the congenital flat-foot.
Fourth, the traumatic.

Of these four, acquired flat-foot is most common. I could describe many varieties under the heading of acquired flat-foot, but with illustrations and descriptions will endeavor to cover the subject as briefly as possible.

ACQUIRED FLAT-FOOT

In the first place I shall describe the form due to long standing, constant walking, weight-bearing and physical deficiency, which is the acquired form of flat-foot.

With the acquired flat-foot the natural springy and flexible action of the foot is soon lost, and the patient notices the inability of constant use of the foot, with pain, and within a short time a gradual or complete change in the structure takes place. There is not always a complete flattening of the arch, but always a slight displacement of the Astragalus, which rotates inward and downward upon the Os Calcis, depressing its anterior and internal border until its movement is checked by the ligaments connecting the bones. The Scaphoid is also depressed, causing a further depressed condition of the arch, especially in the more severe cases where the entire sole of the foot touches the ground. The weight being transmitted by the Tibia upon the Astragalus, the displacement occurs at the inner Malleolus. The ligaments and supporting muscles become stretched and weakened so that there is a gradual subluxation of the various articulations. Natural motion is gradually lost, the ankles are weakened, and by degrees injury is done to the articular surfaces, which is found in the thickened periosteum and cartilage. The foot is considerably length-

Chart No. 55
Severe Case of Acquired Flat-Foot.

ened and, on account of its weakness, also spreads in width. The greatest amount of expansion, however, is at the inner border of the Longitudinal arch, which is due to the depression of the Astragalus inward and downward, forcing the remaining Tarsal and Metatarsal bones forward, while the Os Calcis is forced downward and backward.

There are several degrees of acquired flat-foot. The first degree, or the incipient stage of flat-foot, is where, as we will remember, the displacements of the arch are naturally restored when the patient is seated, and when weight is removed from the feet. The latter condition implies that undue strain has been placed upon the ligaments rather than on the muscles.

Chart No. 56
Acquired Weakened Foot, Early Stage.

The second degree, or pronounced flat-f[illegible]ken-down arch, is where the bones of the arch of the foot [illegible] sl[illegible]y displaced and natural restoration of the arch is not accomp[illegible] when the patient is seated and the weight is removed from [illegible]. In this condition there is considerable displacement of the b[illegible]es and spasm of the Peroneal muscles, and by the displacement of the bones muscular action is interfered with. In this stage it will be noted that the normal motion of the foot is considerably diminished. There is more or less swelling of the foot, and a slight deformity may exist. In

Chart No. 57
Acquired Flat Foot.

the third degree the deformity is accompanied by rigidity. There is more bone displacement downward, and the foot assumes a flattened appearance. The patient is unable to raise himself on tip-toes, and has the characteristic flat-foot attitude and flat-foot gait in walking.

Under this heading could also be mentioned the extreme rigid or osseous flat-foot, in which condition the position of the bones has changed. It is very difficult to successfully treat these cases, and great care should be exercised in applying mechanical aid.

Osseous flat-foot is the result of unrelieved eversion and abduction; it may or may not be a painful condition, but when it becomes firmly

Chart No. 58
Acquired Flat Foot.

established and there is no movement in the Intra-Tarsal joints, the pain arises from uneven Plantar pressure. As all the finer accommodating movements are lost, the bones cannot be shifted to accommodate themselves to alterations in the plane of the body containing the center of gravity, or to changes in those surfaces upon which the foot rests; therefore, callouses will form at those spots receiving the greatest weight, the pain conforming to the extent or condition of these callouses. In this deformed condition (which is a true flat-foot) the foot has lost all of its normal functions except that of support, which is inanimate rather than physiological. In some cases the pain is never

Chart No. 59

Sole Impression of Flat Foot. Sole Impression of Normal Foot.

severe, and in other cases the patient, having accommodated himself to this condition, is unaware of the existing deformity.

Upon examination will be found a prominence at the head of the Astragalus, Scaphoid, and at the Internal Cuneiform, which is due to a partial dislocation. When the patient stands in bare feet there is a decided abduction and pronation, and usually a swelling about the ankle and dorsum of the foot.

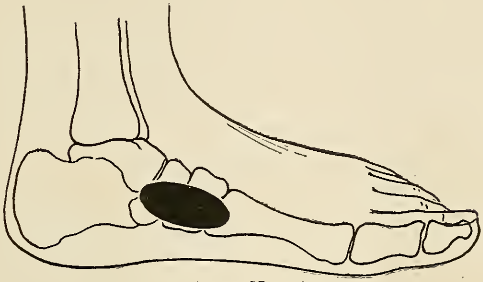


CHART No. 60
Black Spot Shows Location of Pain.

The arch is lowered and considerable pressure is brought to bear upon the inner border. The External Malleolus is depressed and points forward, while the Internal Malleolus becomes more prominent.

CHART No. 61
Flat-Foot, with Finger Pointing to Callous on Great Toe.

Symptoms.—The earliest symptom is usually a sensation of discomfort, of tire, strain and general fatigue; complaint is made that the shoes previously worn do not feel as comfortable, and not infrequently the sufferer purchases various styles and sizes of shoes, seeking relief. There is pain in the heel similar to stone bruise. There is a dull ache in the legs, pain in the knee and pains extending into the thigh, hips and back. There is a general tired, weakened sensation throughout the body, frequently loss of ambition and ability to make any progress either mentally or physically. The foot feels stiff and clumsy, as the finer flexible movements are completely lost.

The patient soon finds that the habit of walking is changed to that of riding on street cars or motors. The feet have lost their

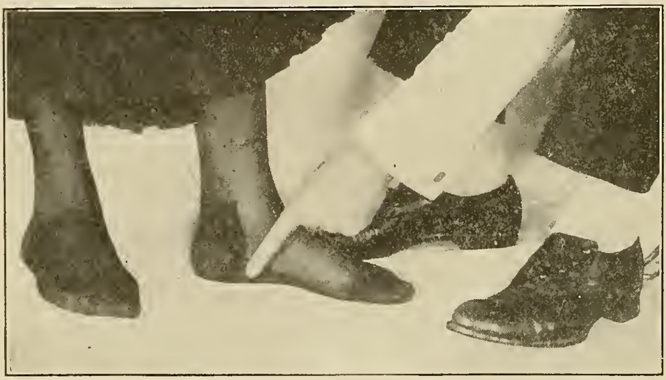


Chart No. 62
Showing Weakened Posterior Arch.

springiness, and there is a general nervous disorder. There is an enlargement of the great toe joint; corns, cramped toes and callouses appear; the feet sometimes feel cold and numb, as the circulation is impaired. Again the feet perspire excessively, and there is a desire for standing on one foot and then on the other, also a desire to place the feet on some object, as the round of a ladder, edge of a desk, or round of a chair in an endeavor to obtain support.

There is local tenderness and swelling, with pain, and there is a change of gait of the person; instead of a quick, alert step, there is a slow, slovenly and dragging walk. Complaint is made of weak ankles. Shoes break open in the shanks, soon lose their shape, and heels are worn down at the inner border. Often the sufferer has pains simulating rheumatism and gout, and not infrequently diagnosed and treated as such. It is found among all ages, but principally those who are on their feet long hours and whose work or habits require them to remain in the same position. It is observed most frequently in the following occupations: Barbers, bartenders, porters, clerks, sales-

Chart No. 63
Severe Case of Flat Foot, Rigid Type.

men, painters, plasterers, laborers, bookkeepers, policemen, motormen, street car conductors, nurses, etc.

It is to be found more among persons who stand or walk slowly than those who walk rapidly. This is probably due to the necessity of obtaining a balance to the body in a tripod position, with the toes everted or abducted. This position permits an unusual strain on the ligaments which give way.

DIAGNOSIS

The most authoritative method of recognizing or diagnosing is by observing the attitude of the patient and the contour of the foot. Again, depressed articulations are manifested by callouses forming on the Plantar surface, sometimes at the heel, with a thickening and roughening of the skin, callouses at the first and fifth Metatarso-Phalangeal joints, and callouses along the inner border of the great toe. Callouses at the latter point are caused by the elongation or weakening of the foot, throwing dead weight and pressure on the distal phalanges and, in the endeavor of the foot to assume its correct attitude, pressure and irritation from the insole of the shoe is produced. Have the patient stand in stocking feet and notice the change of contour with the body's weight on and off the feet.

In the examination, also, the hand should be inserted into the shoe and observations and examination of the inner sole made for location of depressions caused by the toes. In some instances the ball of the foot or the great toe causes a prominent indentation in the insole. If the symptoms are carefully studied and observed with the above suggestions, there will be no difficulty in making a proper diagnosis.

CAUSES

It has been found that the causes are principally mechanical; the strain and the pressure create a disturbance resulting in a weakness of the ligaments. The ligaments, when subject to a continuous strain, soon yield, so the causes are due to the strain produced upon the ligaments. With the ligaments strained unduly, they are unable to hold the bones together, thus a slight separation at the articulations takes place, which in turn allows the bones to interfere with the muscular action.

Long Standing.—Persons who have to stand much usually stand in an attitude of rest, with their feet slightly abducted. In a form of abduction we have seen that the inner edge of the foot is lengthened and there are no muscles actively contracting, so that the ligaments are strained to their utmost in their endeavor to keep the bones in their properly arched position.

Excessive Weight Carrying.—Those who carry heavy weights, such as bricklayers, errand boys, mail carriers, ice men; in such cases the muscles and the ligaments have to support heavy weights in addition to the weight of the body.

Illfitting, Improperly Made Shoes.—Shoes are probably responsible for many cases of flat-foot. They may be termed as the predisposing and sometimes as the existing cause. The pointed toe, the shoe fitted too short and narrow, and the constant changing from one style of shoe to another, which change the articulations, have a tendency to weaken the ligaments.

Chart No. 64
Severe Case of Flat-Foot, Acquired.

Heavy Weight Persons.—In obese persons, with excessive weight borne upon the feet, and the ligaments and muscles in a generally weakened, flabby condition, flat-foot very readily develops.

Rapid Growth.—Children between the ages of nine and fourteen, a period when they grow rapidly and the tissues are expending their energy in progression, have little to spare to meet the extra exertion thrown upon them, and weak ankles and flat-foot develop. In this age flat-foot is very frequently associated with knock-knee and bow-legs.

Short Limb.—Persons with a shortened limb caused by fracture, hip disease or other injury usually throw more weight and pressure on the one foot, producing excessive strain, and flat-foot develops.

CHART No. 65
Flat Foot in Growing Child.

Convalescent Patients.—Those convalescent from acute and serious illness, find the structures in the foot unequal to the pressure of the weight imposed upon them and flat-foot results.

CHART No. 66
Attitude of Child with Flat Foot, Associated with Bow Leg.

Locomotor Ataxia.—Flat-foot is very common among these patients because of the impairment of muscular and ligamentous tone, and to the method of walking. They usually walk with a short rap which tends to throw the posterior part of the Os Calcis upward and the anterior end downward. This induces a gradual sinking and inward and downward rotation of the Astragalus, from which flat-foot results.

Rickets.—Among children, flat-foot due to rickets and general health impairment, is very frequently noticed

Gonorrheal Rheumatism, and general rheumatism, cause a weakness of the muscles and structures which allows the arch of the foot to become depressed.

CONGENITAL FLAT-FOOT

Considerable discussion arises over the correctness of congenital flat-foot. Although leading authorities disagree considerably on the subject, it has been shown that many cases are of congenital origin.

CHART No. 67
Congenital Flat-Foot.

The feet of new-born children are flat, and although there is an inherent tendency for the bones to develop and take shape and position of the bones in the well-formed adult foot, it is not until the child is of an age enabling it to walk that any noticeable development of the arch is apparent. This, however, can be explained by knowing that bone formation in the infant is undeveloped but the heavy paddings of fat somewhat deceive the eye in the course of an ordinary examination.

Congenital flat-foot gives little or no inconvenience to the patient other than the ungainly and ungraceful manner of walking. The foot is abducted, with the toes widely turned out, and with a considerable lack of elasticity and springiness possessed in the normal foot. There is a shuffling, dragging gait, and the foot presents an appearance very similar to that of acquired flat-foot, but there is more of a pronated position and downward sinking of the arch and less rotation of the bones at the Medio-Tarsal joint. Congenital flat-foot is often associated with bunion and hallux valgus condition, and a large percentage complain of no pain or disturbance due to the deformity. Others, whose history would indicate they were of congenital origin, complain of rheumatic pains in the feet, and also limbs, which most frequently occur during their later years of life.

In some instances the weight is carried upon the head of the Astragalus and the foot is quite rigid. A form of ossification having taken place between the joints, these feet are very difficult to fit with shoes, and cause callouses and corns to form from the friction and pressure of the shoe. The treatment for these cases is practically the same as for acquired flat-foot in the more advanced degree. Manipulations, or massage, and forcible correction can also be used with success.

TRAUMATIC FLAT-FOOT

This type of flat-foot, or broken-down arch, is usually produced by a sudden fall, a blow, or weight falling on the instep, jumping from a high distance on to the feet; athletes striking on their feet in such a manner as to rupture and tear the ligaments, severe sprains, and any injury where the arches of the feet have been forced into the flattened position, causing displacement of the bones and complete or partial rupture of the ligaments and straining of the muscles.

This is very evident in cases of Pott's fracture, or where Pott's disease has not been properly treated. There is usually a displacement of the foot at the ankle joint, and unless properly treated in the early stages, the weight of the body in standing and walking will further strain the attachments of the bones, causing a severe deformity.

There is a thickening of the skin and callouses form about the Internal Malleolus, with great pain when use of the foot is made.

CHART No. 68
Traumatic Flat Foot, Caused by Fall From a Height.

TREATMENT

The treatment consists in restoring the bony structures, removing the strain and pressure, which is practically the same as under the head of acquired flat-foot, excepting that more direct pressure and complete restoration of the arches can be made with the aid of tri-spring or tru-span arch supports.

CHAPTER XIX

TREATMENT OF FLAT-FOOT

The first object in mind is to remove the cause, to restore the foot structures to normal condition. The natural movements of the foot must be restored and maintained. Further, it is necessary, owing to the weakened condition of the ligaments, which are unable to hold the bones in their proper position, that the arch be supported until this ob-

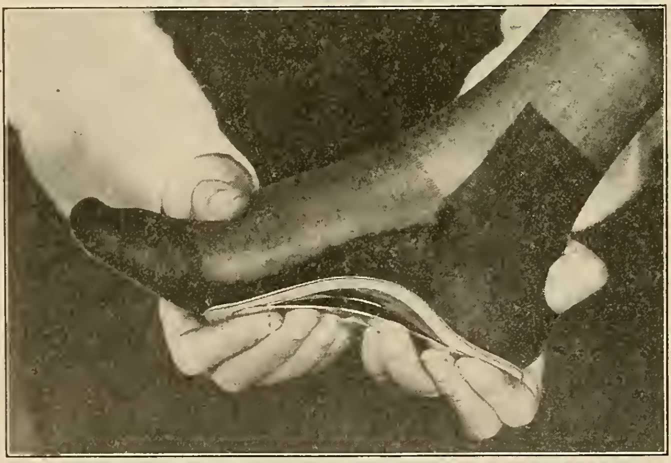


Chart No. 69
Foot-Eazer Type of Mechanical Treatment of Weak Foot Applied to the Foot.

ject has been attained. This method is known as mechanical treatment. Other treatments are bandaging with adhesive plaster, manipulating and massaging, exercise, complete rest, forcible correction (requiring hospital treatment), placing the feet in plaster of paris casts and operation or surgical treatment. Of these varieties, mechanical treatment is most successful because of the fact that persons with flat-foot are usually very active on their feet, and it would be impossible

CHART No. 70
Shoe Showing Effect of Flat Foot or Weakened Foot Where Pads Have Been Used.

CHART No. 71
Same Shoe in Which Metal Support Bridges Weight from Heel Over Shank of Shoe.

to give the medical or required hospital treatment to effect a permanent cure. From my observations I have found numerous cases treated by forcible correction, use of plaster casts, and also rest cure, where pronounced symptoms of the former trouble would return upon active use of the feet.

I have also known similar cases that have been subjected to mechanical treatment, and have received immediate relief. Eventually the feet have been completely restored to usefulness, and this condition permanently maintained.

The vast number of sufferers from this malady makes it important that a means of treatment be resorted to which will give quick relief in removing the cause of pain and inability to use the feet, and gradually restore the foot to normal without the loss of time to the patient. With a properly constructed and fitted mechanical appliance we have a wonderful therapeutic agent, first, giving relief; second, removing the cause; third, gradually rebuilding the structures; fourth, stimulating muscular action and, fifth, permanently correcting the deformity.

Owing to the vast number of theories advanced on what the proper support should consist of, I will briefly bring out what I consider the essentials in a mechanical aid for foot treatment, and I may mention in so doing that the appliances invented by myself have been used with great success in my own practice, and that of other leading physicians and surgeons.

First. The appliance must be one that will give support and correction to the foot quite independent of the shank of the shoe.

Second. It should be constructed on anatomical and orthopedic principles.

Third. It must be made of a material non-corrosive and non-rusting.

Fourth. It must be constructed of a material and design which will permit the most minute adjustments to the requirements of individual cases.

Fifth. It must be of the correct width and length to support the Plantar surface of the foot, and yet not interfere with the needed movements at the Metatarso-Phalangeal junction.

Sixth. It must be so constructed that it can be worn in the regular type of shoe without destroying its shape, and the stock support must be made in a range of sizes enabling quick and easy fitting and adjustment.

Seventh. It must not be heavy, rigid or cause a feeling of encumbrance to the patient.

Eighth. It should be made of light-weight materials for the light-weight person in incipient conditions, and more substantial for the heavy-weight persons with more developed conditions. With these essentials in mind I have carried out the construction of three models. First, a support made with the full supporting plate, having a rein-

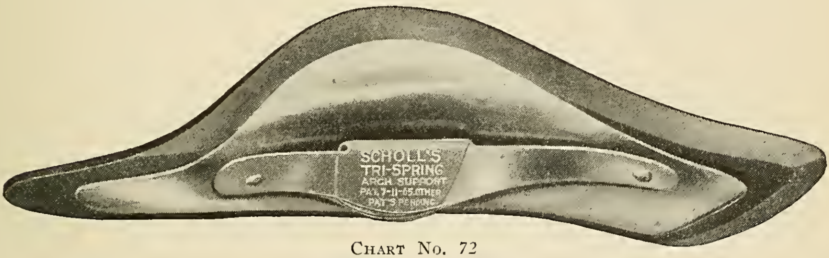


Chart No. 72
Tri-Spring Arch Support.

forcing spring attached, which consists of an additional spring doubling upon itself in the center of the arch, forming a triple spring. The supporting surface of the tri-spring arch support differs from most arch supports in that the elevation of the inner border is more acute and is designed to supply greater force and elevation directly beneath the Astragaloid region. It has an inside flange and is leather covered to make fitting more convenient and to prevent displacement in the shoe. The outer surface of the plate extending under the outer Longitudinal arch is made lower, so as not to cause any pressure at that point.

This support is indicated in the weak foot, the acquired, the congenital and traumatic types of flat-foot. It should be constantly borne in mind that the success of the appliance depends upon its careful adjustment and fitting.

For the weak foot and the incipient stage of flat-foot, and in those cases of acquired flat-foot in their secondary degrees where

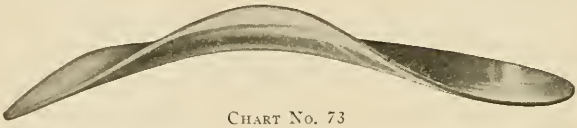
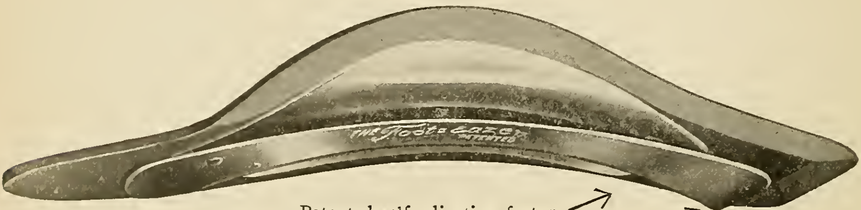


Chart No. 73
Surgical Insole Plate for Flat-Foot.

there is considerable sensitiveness, I use a double-spring constructed device made of springy German silver or silveroid so constructed that the top spring is free at the forward end, permitting a back-

Chart No. 74
Surgical Insole Plate with Anterior Metatarsal Elevation.

ward or sliding motion to the under or supporting spring and affording resiliency, which is most beneficial in the rebuilding of the weakened and deficient arch. The forward motion permits of assist-



Patented self adjusting feature
Friction of Foot-Eazer top plate is on under spring
Chart No. 75
Foot-Eazer for Weakened Arch, Incipient Flat Foot and Sensitive Feet.

ing the articular action of the Anterior Metatarsal and Phalangeal articulations, and I use this, which is known as my foot-eazer, for flexible weak foot, for weakened foot and acquired flat-foot. It is especially recommended for the early stages where there is only a slight impairment of the ligaments noticeable, and where there are symptoms of weak foot development. The advantages I find in this

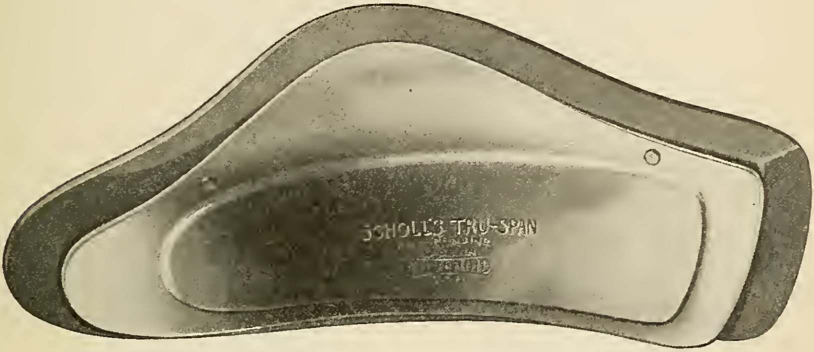


CHART NO. 76
Tru-Span Arch Support for Severe Cases.

device are in its furnishing a quick and easy means of removing the strain and restoring the balance and equilibrium to the foot without resorting to the extreme measure in recommending change of shoes or

CHART NO. 77
Showing Tri-Spring Arch Support Fitted to Foot.

requiring readjustment to the modes of walking. With the early symptoms of fatigue, cramping toes, aches and pains through the foot, a support which is easily adjusted will give immediate relief and restore the foot so that the device may be discarded within a comparatively short time.

In the extreme rigid and osseous flat-foot and for severe cases where considerable resistance must be met, I construct a plate with a short depressed opening in which I insert a further strengthening plate, assembling the two to aid in furnishing the necessary support. This I term as tru-span, which I find most useful in the severer cases, And these three patterns, with the Anterior Metatarsal arch support,

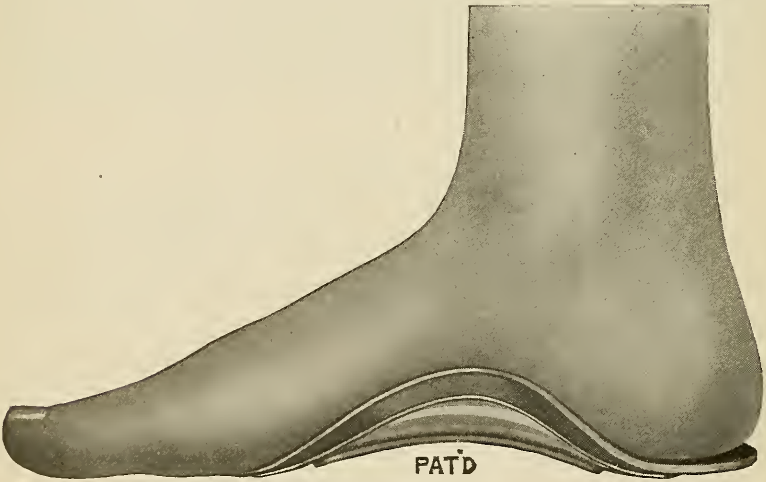


Chart No. 78
Tru-Span Arch Support for Heavy Weight and Severe Cases.

afford the armamentary for all valgus conditions of flat-foot. These appliances are made of material that will permit the adjustment to each and every case, and which are undisputably necessary elements in the correction of foot troubles.

As the subject of adjustment is a very important one in the treatment of foot deformities by mechanical appliances, I have written a special chapter showing how these appliances are adjusted to meet the requirement of each individual case. When the supports are properly fitted they should cause no discomfort and relief should be immediate, as the foot is held in a corrected position and the support becomes a positive aid in effecting a physiological cure. The length of time required to effect a cure depends upon the case, advancement of the weakness, mode of walking and the style of shoe worn. Great care must be exercised in advising that the shoe be of correct length and shape, snugly fitted through the waist and heel. Modified heels are recommended where the patient has not become thoroughly accustomed to an extreme high heel, in which event the height of

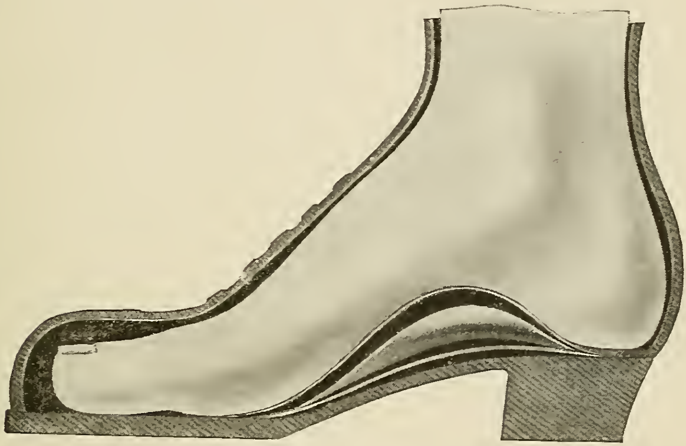


Chart No. 79
Showing How Weak Foot is Supported with Foot-Eazer without Depending on Shank of Shoe. Note How Foot is Drawn Back and Held in Position.

the heel should be gradually lowered. The supports are best fitted to the foot of the patient and adjustments made regularly until a cure is effected. These appliances may also be fitted to outlined or penciled diagrams of the feet, which may be taken by having the patient seated with a sheet of paper placed under both feet on the floor, and pencil outline drawn around the foot. Then, without lifting the foot, have patient stand with entire body weight on the feet and a second drawing made around the foot, indicating thereon any prominence as Rotated Astragalus, extreme Pronation, long or short heel. Then a line is drawn between the first Metatarso-Phalangeal joint to the fifth Metatarso-Phalangeal joint on the diagram. The support is then fitted to accommodate these lines. In no instance should these appliances be fitted according to shoe size. They may be fitted and also made over plaster paris casts taken of the foot. I have allotted a complete chapter on how to take plaster casts so that the student may have full directions before him in the event that these should be necessary. Read carefully Chapter XXI on fitting of appliances.

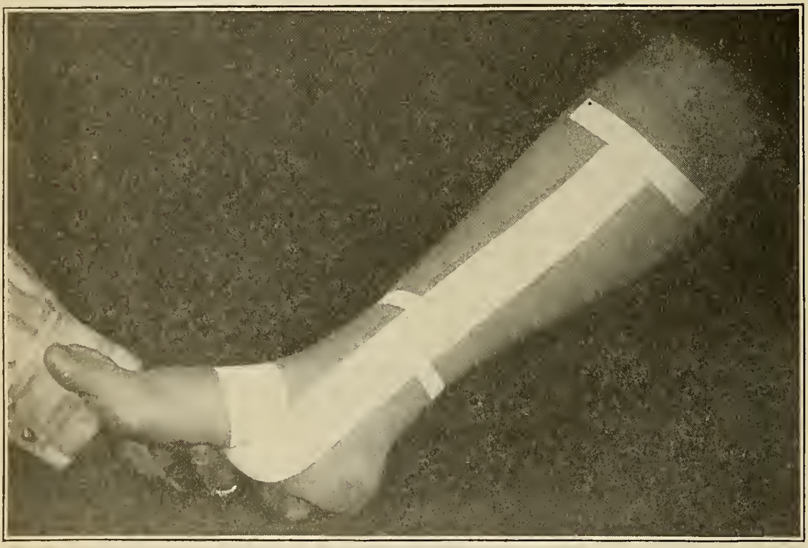


Chart No. 80
Method of Strapping for Flat Foot, Single Strap.

Bandaging and Strapping.—While the use of bandaging and strapping is not practical for general use, in some instances of acute attacks adhesive plaster bandages can be successfully used. This is done by first having the patient seated and placing the foot on a stool, with the foot abducted, over-corrected; a strip of plaster 14 to 16 inches long and 2 to 3 inches wide is applied to the outer side of the ankle just below the External Malleolus. The foot is again carefully abducted and corrected, and the plaster is then drawn tightly beneath the sole and up over the inner border of the arch and attached to the inner side of the leg. A second plaster strip may be applied in the same manner, and then with narrow bandages this is stayed in place. This is sometimes used in the early stages and worn from five to ten days, after which an arch support is properly fitted. Great

CHART No. 81
Method of Strapping for Weak or Flat Foot, Double Strap.

care must be taken in applying the bandages, otherwise the restoring action and articulation will be impeded. This method is also used by placing a felt valgus pad in position beneath the arch and held in place by similar bandages.

Exercises.—Certain exercises may be used after the early stages of weak-foot development, which are often beneficial. The object of exercising is to develop muscular action where there is a deficiency, but not until the ligamentous causes have been removed by proper

CHART No. 82
Method of Bandaging with Strapping for Severe Flat Foot.

mechanical treatment. Inverting the feet, that is, standing with toes in, and rising on tiptoes ten to fifteen times, first very slowly and then more rapidly as soon as accustomed, and extending and flexing the toes, are also very helpful in restoring foot action.

CHAPTER XX

METATARSALGIA—MORTON'S TOE

Weakened Transverse Arch.—This condition occurs in the Anterior Metatarsal arch, or what is known as the Anterior Transverse

CHART No. 83
Case of Metatarsalgia Showing Callouses on Sole.

arch, which is formed by the Metatarsal heads and consists of a dome-like shape between the first and fifth Metatarsals. The deformity consists of a slight displacement or depression of one or more of the Metatarsal heads, and while there may be no particular displacement in the early stages, there is a weakened condition in the supporting ligaments which permits slight displacements in walking, or when weight is thrown upon the foot.

Morton's Toe and Morton's Neuralgia were first described by Morton of Philadelphia. Other typical cases of this painful affection

CHART No. 84
Finger Points to Usual Location of Pain.

of the foot occur with severe pain and a sudden cramp-like sensation between the third and fourth, or fourth and fifth Metatarso-Phalangeal articulations. The pain may begin with burning, tenderness and swelling, extending through the Dorsum of the foot, and it frequently extends to the extremity of the toe and up to the foot and leg. In some cases the pain is preceded by a sensation of slipping or moving of the joint. Again it is of a mild character, and in the severe cases the cramp-like pain comes on with such suddenness and severity that the sufferer is compelled to remove the shoe, compress the foot and relieve the pain by extending the toes and by manipulation to relieve the cramp. It is by continued stretching of the capsular

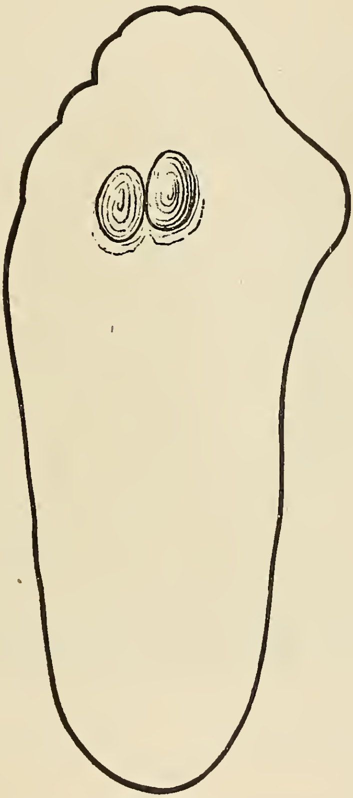


Chart No. 85
Outline of Foot, with Depressed Metatarsals and Callouses.

ligaments that the sensitive synovial ends of the bones are uncovered and exposed to pressure. The pain and excruciating cramp are caused by the impingement of a branch of the digital nerve.

As our anatomy shows us the protective tissue over the Metatarsus is very thin and a giving way of the Anterior arch at this point results in many cases of the joints becoming permanently and partially dislocated and displaced. With the giving way of the Anterior arch undue weight is thrown upon the displaced and frequently dropped Metatarsal heads, causing callosities to form and the resulting burning sensation on the sole of the foot between the first and fifth Metatarsals. There is also a thickening of the anterior part of the

Chart No. 86
X-Ray of Weakened Anterior Transverse Arch Showing How It is Spread Laterally.

foot and usually manifested by severe hallux valgus, overlapping toes, enlargement at the first and fifth Metatarsals and the formation of corns on the top of the distorted toes. These conditions are found more frequently among women than among men, partially due to the fact that shoes with narrow toes, tight across the anterior part of the foot, higher heels which force the foot into a wedge-like shape, all have weakening effects on the foot structures. Again, in some instances, history would denote that it is a family inheritance; the affection is usually extremely chronic with recurring pains, the cramp-like attacks coming at the most unexpected time. This condition is without doubt the most prevalent of any foot disorder, yet one which is rarely recognized until the severe stage of pain.

Chart No. 87
X-Ray Print Showing Metatarsalgia and Spreading of the Fifth Metatarsal Bone.

In this condition weak ankles, loss of balance, weakened Longitudinal arch and elongated foot are also found. In some cases the concavity of the Transverse arch is entirely absent, so that a prominent convexity is formed with callouses covering the entire area. It usually occurs in one foot, but sometimes in both feet. There is numbness and swelling and local pain, and temperature may be present with severe pain following through the foot, leg, thigh and back. When weight is borne upon the foot, the foot elongates, widens and spreads, and weight is then thrown upon the weakened or displaced Metatarsal, which may be the third, fourth or fifth. Upon examination will be found redness, tenderness and callosities; sometimes in

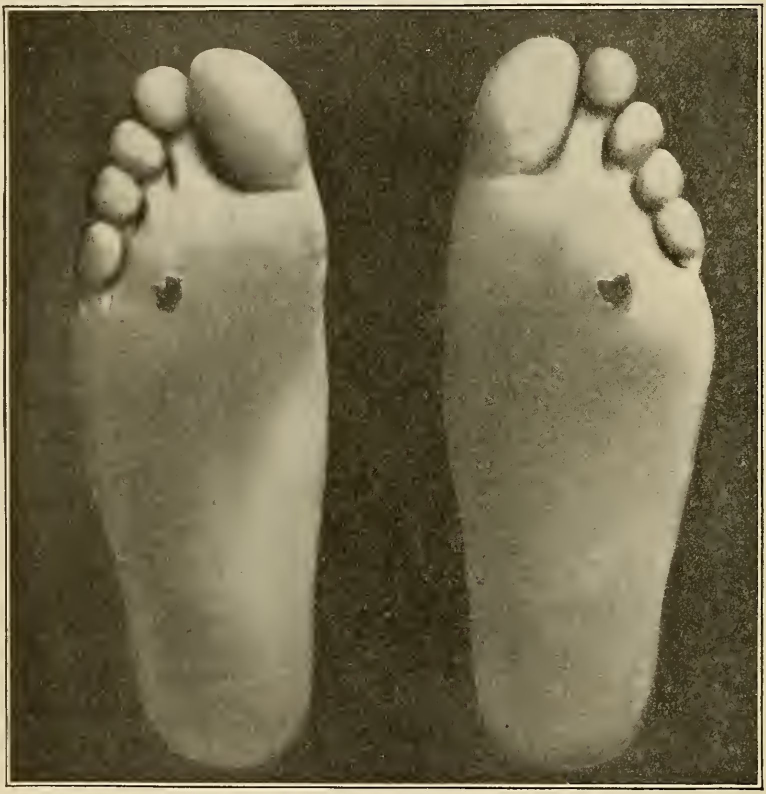


Chart No. 88
Metatarsalgia, with Painful Callouses and Ulcerations.

spots, or sometimes in small areas covering one or more of the Metatarsal heads; oftentimes the tissues seem to be dense and offer more protection, but with the toes contracted and dorsiflexed.

In a few cases small bony enlargements have projected from the heads of the Metatarsal bones, and in others fibrous growths have been found in the subcutaneous tissues. In any event it is the cause of weakness, strain, pressure and dislocation or displacement.

Diagnosis.—Diagnosis of this condition is first usually recognized by the description given by the patient and history of the case. Cases where there has been an impingement of the Digital nerves, or where the cramps and pains have been sudden and severe, to make examination, the heel should be grasped by the left hand and with the toes extended, pressure produced, and a test made for mobility of

Chart No. 89
Metatarsalgia with Pronounced Thickening Due to Depressed Metatarsals.

the foot; then with both hands, with the foot still at rest, cause pressure to the Metatarsals with the thumbs. (Charts Nos. 91 and 93.) Make a test to discern whether the natural dome-like arch is lost, and to locate the positioning of the depressed Metatarsals: as the greatest average of pain is found between the fourth and fifth Metatarsals the examination must be very carefully made in this region. If the toes assume a cramped, dorsiflexed position, or appear to be contracted, there is usually a marked prominence of the muscles and tendons of the Dorsal surface, and there is external indication of irritation at the base of the fifth Metatarso-Phalangeal joint, and usually redness. If the shoe worn by the patient is examined it will be found that the upper leather spreads considerably over the sole,

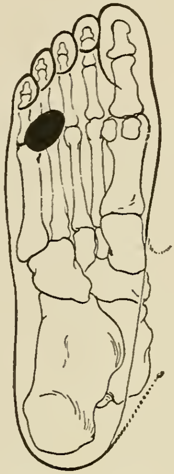


Chart No. 90
Black Spot Indicates Location of Cramp and Severe Pain.

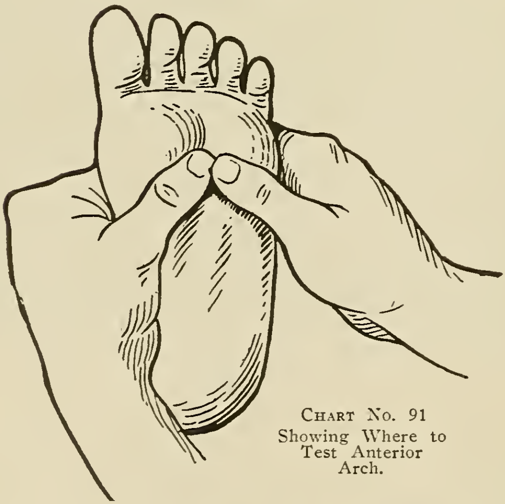


Chart No. 91
Showing Where to Test Anterior Arch.

and that the sole at the tread is worn very unevenly. This is brought on by the widening and thickening at the ball of the foot. In many cases the examination would show a normal foot other than the weakness apparent when weight is placed upon the foot and a spreading noticed between the first and fifth Metatarsals. (See outline diagrams, Chart No. 92.)

One of the most usual symptoms for diagnostic purposes is the contour at the Anterior arch, cramped toes and thickening of the sole with callouses. This condition is found among men, women and growing children.

CHART No. 92
Showing Abnormal Spreading and Widening Between AA and Enlargement at First and Fifth Metatarsal Joint. Lines BB Show How Foot is Made Narrower when Transverse Arch is Supported.

Treatment.—The treatment indicated in these cases is mechanical. Surgical operations are very rarely resorted to. The treatment should be of a local order, with an object in view of restoring the weakened structure and replacing the displaced Metatarsals. This is best accomplished by an arch support especially constructed, with its object to remove all strain and pressure, to maintain the natural balance by supporting the Longitudinal arch thoroughly, and giving the right adjustment to the Anterior arch. The appliance which I have used since 1906 for this purpose is known as my Anterior Metatarsal arch support, which is constructed of a light-weight silveroid alloy metal, peculiarly shaped to fit the heads of the Metatarsals, having a wide

Chart No. 93
Testing Foot for Anterior Arch with Thumbs.

bearing point and a dome-like curvature between the first and fifth Metatarsals. The success of this support lies in the adaptability to the various conditions found in each individual case, which must serve to firmly support the Longitudinal arch, thereby removing considerable weight and pressure from the Anterior arch. The plate must be

CHART No. 94
Applying Anterior Metatarsal Arch Support with Flange to Foot for Size.

CHART No. 95
Anterior Metatarsal Arch Supports in Three Patterns.

of a full length, or nearly a full length from a point ⅜ inch back of the Metatarso-Phalangeal articulation, extending back to the heel; the degree of elevation to the Anterior arch depends upon the condition of the foot. In mild cases restoring the natural dome of the Transverse arch is sufficient. In other cases an added elevation must be produced directly behind the displaced Metatarsals. Again it becomes necessary to produce an elevation egg shaped, the size of a walnut, which has a tendency to tighten the ligaments controlling

Chart No. 96
Anterior Metatarsal Arch Support, Fitted One with Stocking, Other Without.

the Anterior arch. Care must be taken in fitting and adjusting the arch supports for these cases.

In the milder cases of callosities I use my Anterior Metatarsal arch support with the flange, and in incipient cases I use an Anterior Metatarsal arch which is so constructed as to give support only to the Transverse arch in the anterior region.

Occasionally a felt padding with kiro pads and a band of adhesive plaster drawn around the waist of the foot will give temporary aid. Mechanical supports, however, are usually more satisfactory because they do not rely upon the shoe for a base of support or strength, as would be the case with felt or leather paddings. Paddings attached to the inner sole of the shoe have also been used, but are not so successful because of the serious difficulty in properly arranging the pad.

CHART No. 97
Kiro Pad for Giving Mild Support to Transverse Arch.

Then again in many instances, owing to weakness of the Longitudinal arch, the position of the Anterior arch changes considerably in the process of walking, and when my Anterior Metatarsal arch sup-

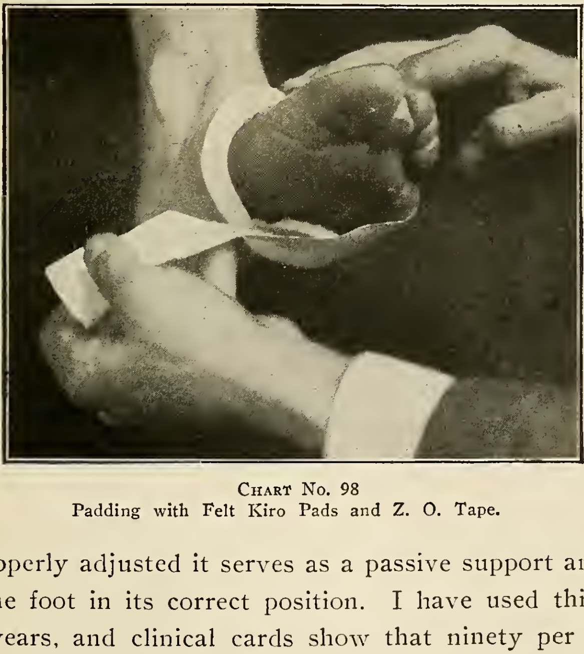


CHART No. 98
Padding with Felt Kiro Pads and Z. O. Tape.

port is properly adjusted it serves as a passive support and assists in holding the foot in its correct position. I have used this treatment for nine years, and clinical cards show that ninety per cent of the patients have obtained permanent relief from the painful condition treated.

Massage, forcible correction and careful judgment in fitting the foot to modified shoes are also necessary. The sensitive callouses may be removed by the chiropodist's method or with pedico callous

Chart No. 99
X-Ray Showing Anterior Metatarsal Arch Support in Position to Relieve Severe Cramp in Third and Fourth Toes.
Note Plate Cut Away Under First Metatarsal Head.

salve, but it should be borne in mind that the callouses are the result of the constant pressure and irritation of one or more of the Metatarso-Phalangeal articulations, in which a positive cure can only be assured by supporting the arch and removing the friction and pressure with the Anterior Metatarsal arch supports.

A Typical Case.—To show the necessity of mechanical correction, the history of a typical case is here given. It is the case of a young lady who was twenty years of age when the case was first brought to the author's attention.

At the age of thirteen she became aware of pains in her feet and limbs, and developed extreme nervousness. Her physician said she had been studying too hard and advised a rest from school. Six months' absence failed to stop the nervous irritation or the cramps in her feet. Internal remedies and tonics did no good. A New York specialist prescribed gymnasium exercises, loose clothing and a discontinuance of her studies.

Finding no relief she consulted an orthopedic surgeon who recommended specially made shoes, which gave relief when first worn, but the trouble returned and she was advised to go to a hospital. There her feet were placed in plaster of paris casts for six weeks, the period of enforced rest bringing temporary relief. Soon thereafter the pains and nervous condition returned.

Then an orthopedic shoemaker came into the case at considerable expense to the patient for shoes and service, but she still obtained no relief.

Some time after this the case was brought to the author's attention, without any of the particulars being given him at that time relative to former treatments.

The trouble was soon located, the young lady fitted to a pair of Anterior Metatarsal arch supports and told to walk around for half an hour to test the fit. Expressing great satisfaction at the comfort and relief afforded, she admitted it was the first time in years that her feet had really felt comfortable.

A week later she reported that she was still enjoying perfect foot comfort and entire relief from nervousness, together with great general improvement in health.

The third week she had another pair fitted and was advised to purchase shoes that would fit the heel and waist more snugly and allow plenty of toe room. This she did and her report of over a month later expressed the greatest satisfaction. She said she had no pains or discomfort whatever and her health was excellent.

CHAPTER XXI

METHOD OF FITTING ARCH SUPPORTS

I have so frequently been requested by students and by practitioners to give them an outline as to my method of fitting corrective appliances, that I believe a chapter on this subject will be of great value and interest to the reader. It is very important to recognize that in mechanical appliances we have an armamentary of undisputed value in the treatment of foot deformities, but the success of these treatments and devices depends greatly upon their application

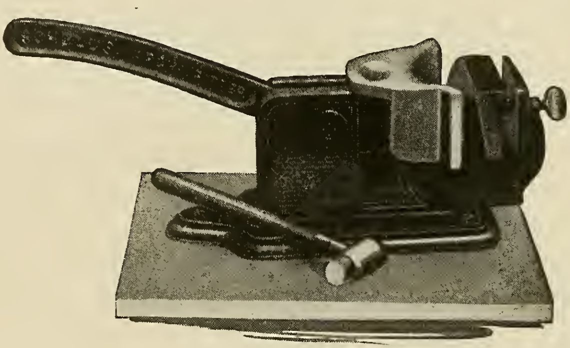


CHART No. 100
Arch Fitter and Rawhide Hammer to Take Place of Vise and Anvil.

and upon the intelligent selection and fitting, adjustment and advice to the patient regarding their wearing.

Using the words of a prominent orthopedic surgeon, "there is also associated in the minds of the laity and the profession that the treatment of all foot troubles is the question of arch supports. Few patients complaining of their feet come to the orthopedic surgeon who have not worn at least one of the variety on the market and,

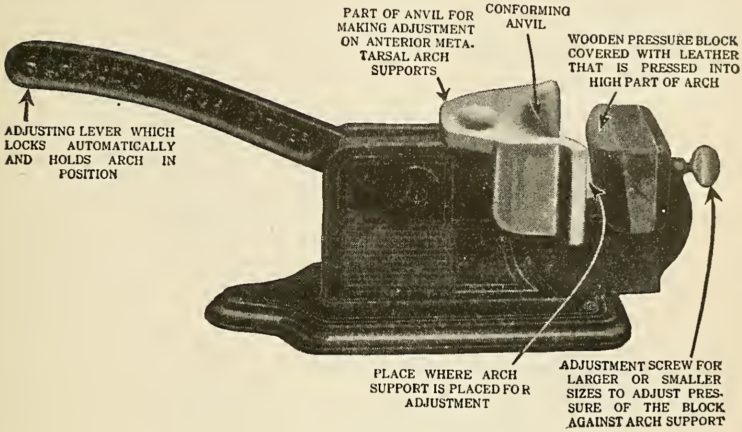


Chart No. 101
Showing Mechanical Parts of Patented Arch Fitter.

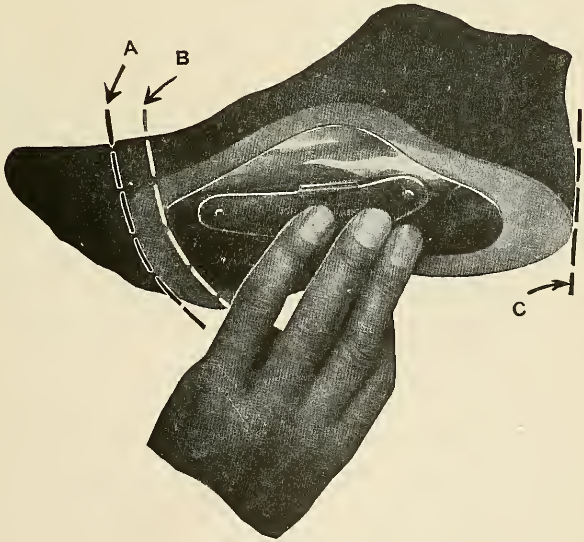


Chart No. 102
Diagram Showing Correct Length of Arch Support Leather from Point C to Line of Metatarso-Phalangeal Articulation A. Metal Extends Within 3/8 inch or at Line B so as not to Interfere with Ball Movement.

although the practice of unprofessionally prescribing arch supports should be unreservedly condemned, I should not be surprised if shoemakers and salesmen of these articles have cured as many pain-

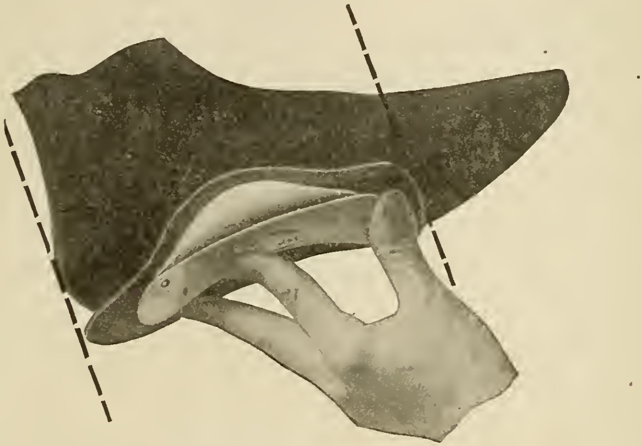


CHART No. 103
Selecting Correct Length Flush with Rounded Part of Heel to Metatarso-Phalangeal Joint.

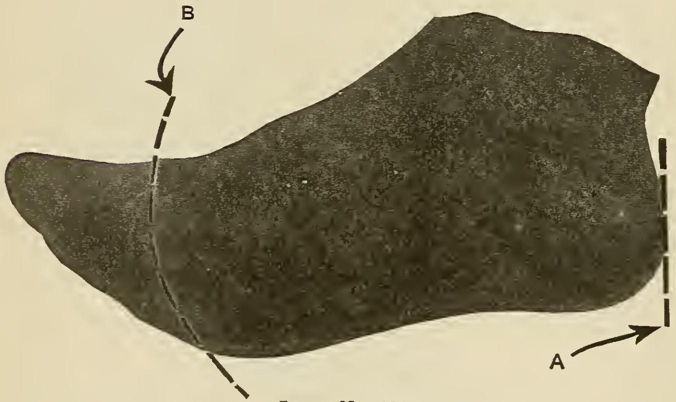


CHART No. 104
Diagram Showing Points to be Fitted with Arch Supports to Extend from A to B.

ful feet as have physicians." A statement of this kind confirms my belief that it is within the power of the shoe-fitter and the chiropodist to do much toward alleviating, through correctly fitted mechanical devices, the pains and annoyance caused by foot deformities, but it is certainly important and necessary to base the fitting and adjustment upon physiological and anatomical facts. Experimentation and "try this" or "that" method should not be resorted to. There are laws of balance, of gravitation, centralization and correction in this work that should govern us. We know fully too well how closely allied are the arteries, bones, nerves and important tissues of the foot to other parts of the body, and in the fitting of appliances these structures must be given consideration.

I take it for granted that the selection of the arch support has

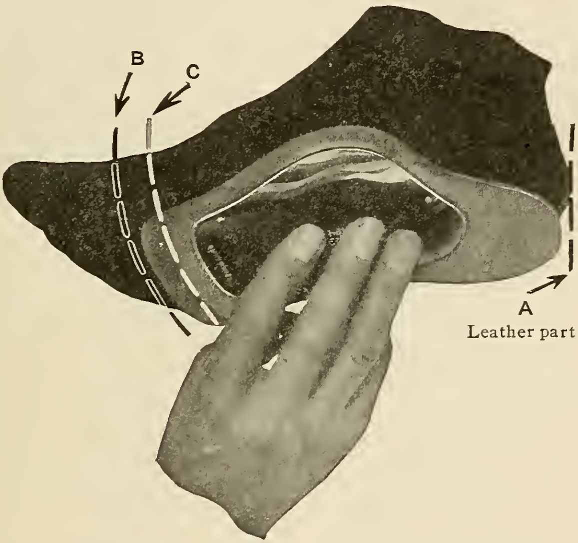


CHART No. 105
Diagram Showing Shortly Fitted Arch Support Held to Foot. Leather Part Should Fit from A to B, while Metal Should Fit to C, to Span Weight Over Shank of Shoe.

been made, as I firmly believe that properly constructed stock arch supports, when there is choice of selection, are in an average run of cases as practical and adequate as making supports from individual casts. (I refer to those made on practical and scientific lines.) The supports, however, must be built on principles that are orthopedically correct and must be constructed of material which will permit the necessary adjustment to be made. Now that we are supplied with the arch supports, without question the next point to consider is a means by which these particular adjustments can be made. I use a patented arch fitter and a steel rawhide faced hammer for the purpose of adjustments and fittings. (See Chart No. 100.) This arch fitter is constructed of malleable iron and steel to act as an automatic vise, having a steel conforming anvil and wooden pressure block and

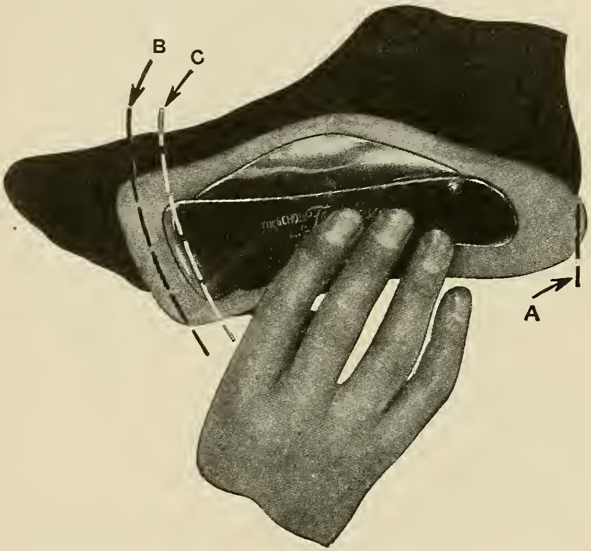


Chart No. 106
Showing Foot-Eazer Fitted too Long. Correct Length is from Point A to B for Leather, while Metal Should Come to Point C.

adjustment screw, with a lever for manipulating. (See Chart No. 101.) It affords a quick and accurate means of making adjustments without resorting to the blacksmith shop anvil method. (See Chart No. 114.) Although the beating out, or hammering to shape, plates of German silver, soft steel, brass, copper, etc., has been the old-time method of the bracemaker, I believe that to be efficient the orthopedist should be qualified to gauge his adjustment according to the condition of the case being treated. There are no two feet exactly alike, and it is not at all uncommon to find it necessary to make adjustment for one foot entirely different from that for another. This is very nicely handled with the use of this arch fitter. Selecting the right size and the correct length of the arch supports is of the utmost importance. Those varieties that are covered with leather for additional protection to the foot should be selected to extend from the point flush with the rounded part of the heel so the thinly skived point of the leather reaches the first Metatarso-Phalangeal joint. (See Chart No. 103.)

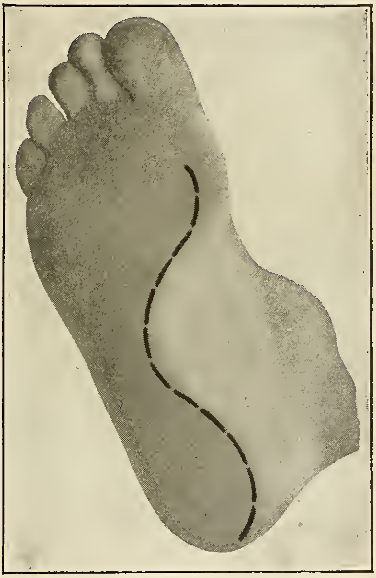


Chart No. 107
Dotted Lines Indicate Where Most Pressure Should Be Given in Fitting Supports for Arch Trouble.

In the construction of my appliances I always allow three-eighths of an inch from the forward edge of the metal to the extreme edge of the thin part of the leather covering. In that way I may gauge my correct fitting by the lengths of the leather, as noted in diagram. (See Chart No. 103.) This shows the flush fitting at the heel and the articular point to avoid at the Metatarsal arch. I show in my diagram the stockinged foot, as it is more convenient and more practical as a rule to fit over the stocking. The arch support or foot-eazer should then fit in length from the heel part forward to the first Metatarso-Phalangeal joint or at the ball of the foot where the foot bends.

In the selection of the size of the arch support to be fitted to the weak flexible foot, where considerable elevation and adjustment is to be made, a longer size must be selected to allow for the shortening or drawing up of the appliance in the process of elevation. Care must be taken to obtain the correct length, as a shortly fitted appliance

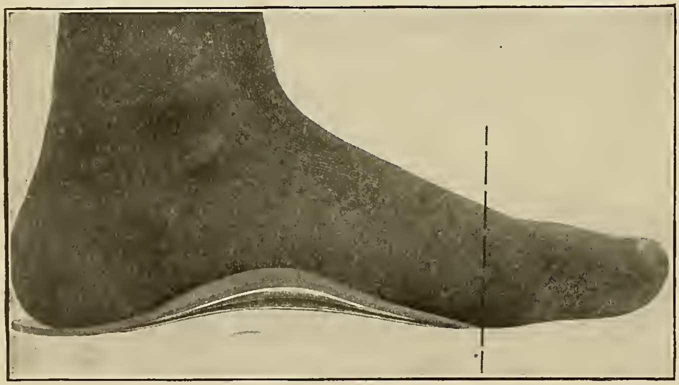


CHART No. 108
Care to See That Leather Extends Flush Under Heel
Above Shows Flat-Foot Properly Fitted so That Support Touches All Points Evenly.

rests upon the shank of the shoe, which is insufficient to bear the weight, and in a very short time breaks down, creating a very poor appearance of the outlines of the shoe. Selecting the proper width is also very important. I find it necessary to construct the supports in two widths, wide and narrow, and this applies to the metal springs as well as the leather. Wide, short or fleshy feet should be fitted wide so that a substantial bearing point for the Plantar surface may be had, yet not so that the support will distort the shoe.

If an all-metal plate or surgical insole be fitted it must then be fitted three-eighths of an inch behind the Metatarso-Phalangeal joints. There are variations to consider, especially where there is undue prominence of the Metatarsal head, from which pressure should be avoided. Now, with the arch fitter securely fastened so that it may be manipulated without shifting, you are now ready for adjustment. First select the size of support; then, placing the support against the Plantar surface of the foot, notice whether it touches all

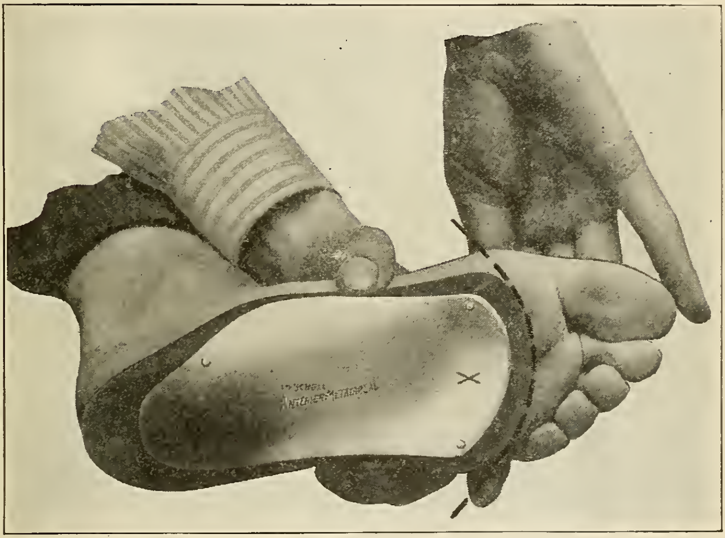


Chart No. 109
Showing Correct Length of Anterior Metatarsal Arch Support.
Leather to Fit to Dotted Line.

points of the Longitudinal arch evenly. The patient's foot is to be relaxed and the fitting done with the foot in a position of rest. If not, the necessary adjustments must be made. When the support is properly fitted it will touch all points of the arch smoothly and evenly, holding the foot in its correct position. Several adjustments and operations may be necessary on the support before it will absolutely fit the condition. When the fitting is made properly there is an evenly distributed, well directed pressure at all points which insures comfort and relief at once. Care must be taken that there is sufficient length of leather or a bit of metal plate immediately under the heel, so that there is a pad for the heel to rest upon. (See Chart No. 108.) If the arch is considerably displaced and flattened, so that the arch support appears too high, it is then best to commence the fitting by first lowering the support. To do this place the support on the conforming anvil, metal part down, and with the rawhide faced hammer

CHART No. 110
Placed to Plantar Surface to See What Adjustments are to be Made.

tap the top side of the leather support gently but firmly, then apply to the Plantar surface of the arch and notice where the elevations are to be made. Then place the support between the conforming anvil and pressure block, drawing the leather toward you, and tapping that part of the support to be raised with the rawhide faced hammer. (See Chart No. 114.)

It must be borne in mind that rigid flat-foot cannot withstand the same amount of pressure as the flexible flat-foot, or the weakened flexible foot, either of which may withstand a greater amount of correction or pressure from the supports. To obtain adjustments to these conditions the same rule should apply in selecting the length and elevating the support so as to touch all points of the Plantar arch evenly and smoothly, but not severely.

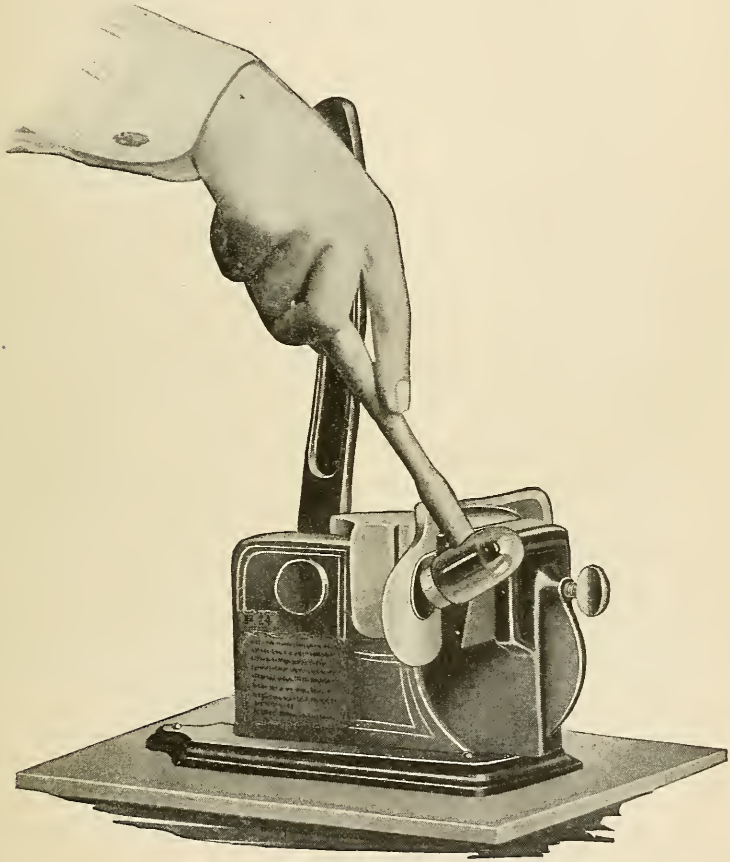


Chart No. 111
Elongating Heel so as to Make a Heel Bed for the Depressed Os Calcis or Elongated Heel.

In those cases where the posterior region of the Longitudinal arch may be affected, the Os Calcis is forced down and backward, making a long heel, and more flattened surface under the heel. For this condition the heel part of the arch support should be elongated, giving a longer surface for the heel to rest upon. This is done by placing the support between the conforming anvil and pressure block (see Chart No. 111), having the heel part drawn out away from the machine until the distance between the end of the heel part of support and extreme edge of the conforming anvil is the distance where elongation adjustment is required. Then gently tap the metal part at the heel, straightening it as shown in Chart No. 113. Then again fit to the patient's foot, noting what further changes are needed, and readjust

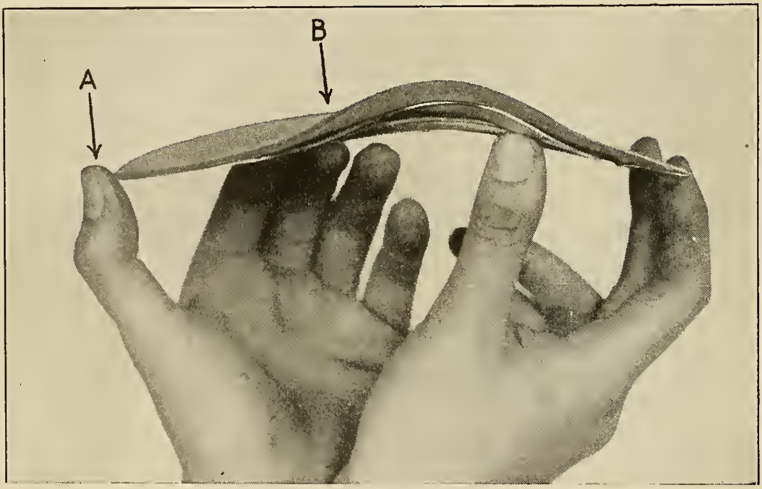


Chart No. 112
Showing Foot-Eazer Adjusted to Fit Long Heel. Note Heel Bed A to B.

so that the entire support fits all points of the foot. The manipulation of this particular adjustment for elongated heel is very important, for if it is not properly done the support is apt to slide forward so that the heel of the foot is not protected all over by the leather covered base. After the foot is properly fitted with the arch support then place in the patient's shoe and learn if the support sits firmly in the heel seat, and at the point forward of the shank, and fits so that no weight or strength is thrown upon or required of the shank part of the shoe. (See Chart

No. 116.) It is very important to be sure that there is no rocking or tilting of the support inside the shoe, and that it sits firmly in the heel seat and forward part of the shank. Arch supports, when fitted to the foot, should then be fitted to that particular type of shoe. The poise of the foot is changed in various extreme styles of footwear. High heels and low heels considerably alter the poise and balance of the

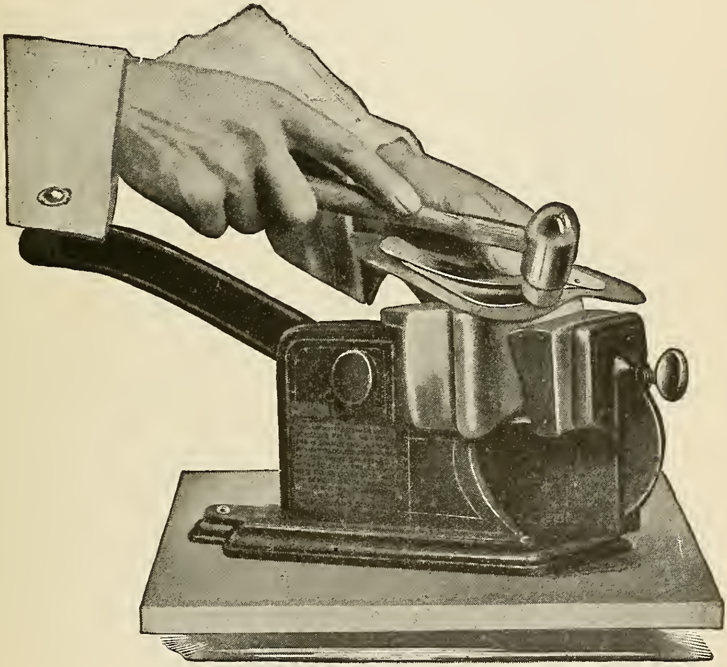


CHART NO. 113
After Heel is Elongated as No. 111, Support is Placed on Rounded Part of Conforming Anvil to Straighten Any Uneven Points.

foot, and the support should first be fitted to the foot and then placed in the shoe to make sure that it fits at both points, heel seat and forward of shank, and if so there should be no slipping or forcing the heel out of the shoe. (See Chart No. 117.)

The rule, as I have given you above, applies to the fitting of the Anterior or Transverse arch. The metal part of the support should always remain about three-eighths of an inch from the Metatarsal articulations, and the style of Metatarsal arch support for Metatarsalgia and Morton's toe must be governed by the age of the patient, condition of foot and severity of the case. When there is pressure

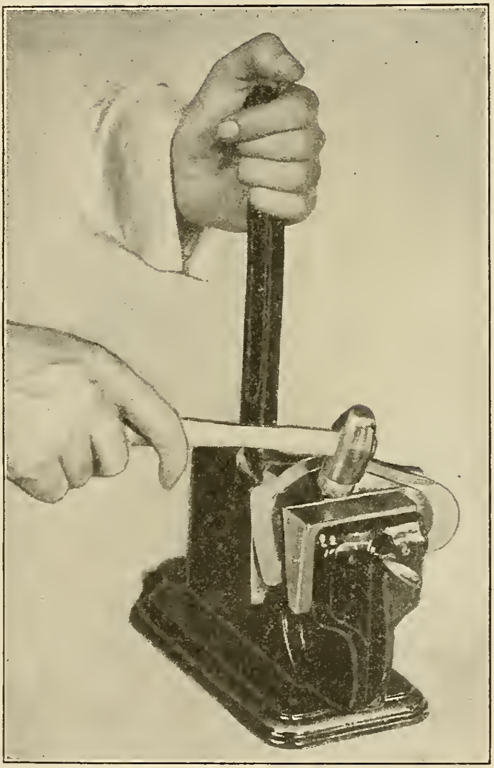


CHART No. 114
Elevating Arch Support. Note Line on Which the Rawhide Hammer is to be Used.

upon the third or fourth Metatarsal head, which is indicated by callosity and tenderness, the elevation to the anterior part should be made in a dome-like shape from the first to the fifth Metatarsal, but most exaggerated just beneath and behind the dropped Metatarsal.

In severe cases of Morton's toe and Metatarsal pains the elevation may be placed between the third and fourth Metatarsal heads. Sometimes it is necessary to make these elevations the size and shape of a large olive, and again only a slight oval shape is necessary.

These elevations and fittings are very easily accomplished by my method, and the use of the arch fitter, as the conforming anvil has an

Chart No. 115
Dotted Lines Indicate Where Most Pressure is Required for Metatarsalgia.

oval depression in which the metal may be hammered to shape. The following schedule may be used as a guide in determining the adjustment:

Weak Flexible Foot—Relaxed Foot.—Use light spring support snugly fitted, most elevation directly beneath Inner Malleolus.

Moderate Flat-Foot, where structural change has taken place, requires support fitted evenly, but not extremely high. Adjust when the weight is off the foot.

Extreme Flat-Foot With Swelling.—Fit all points of arch when the weight is off the foot. Make adjustment low.

Rigid Flat-Foot With Adhesions.—Fit arch support extremely low, taking care to prevent skin or local irritation from pressure at any near point of the flange of the arch support.

Weak Arch With Enlargement at First Metatarso-Phalangeal Joint.—Fit arch supports to all points of Longitudinal arch snugly,

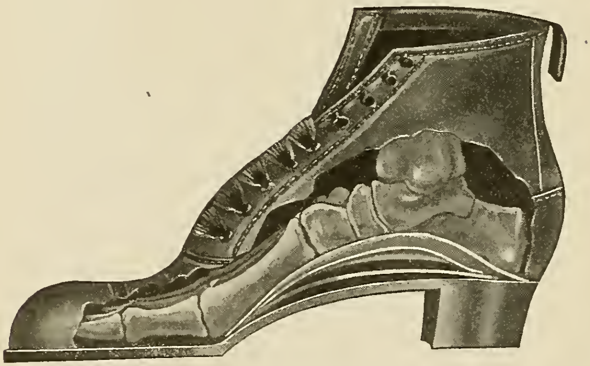


Chart No. 116
Shows Support After Adjustment and It is at Once Obvious That Room has Been Given for the Heel to Sink Before Actual Arching of the Support Takes Place.

then give added elevation to furnish added support just behind enlarged joint to remove dead weight and pressure. Light, springy support is indicated.

Weak Ankles and Inward Rotation.—Fit supports to permit support and pressure directly beneath ankle joint to hold it firmly in position.

Extreme High and Contracted Arch.—Fit arch support high in center allowing space of approximately one-eighth inch between highest point of arch and highest point of arch support. Support

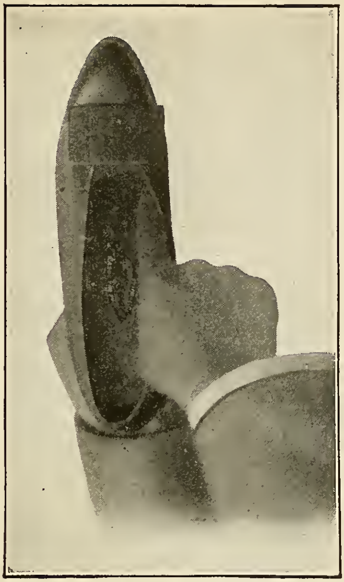


CHART NO. 117
After Support is Fitted to Foot, Place in Shoe to Test Fit in Heel Seat to Prevent Slipping.

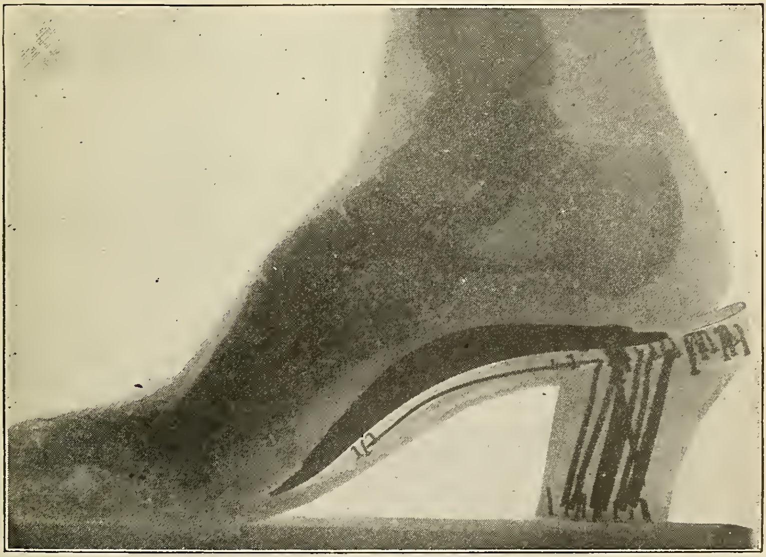


CHART NO. 118
X-Ray of Woman's Foot, Fitted to Arch Support which Also Shows Bearing Points of the Support Inside the Shoe.

should be fitted a trifle longer than ordinarily, to give slight super-expansion forward.

Metatarsalgia and Morton's Toe, Cramped Toes and Displaced Metatarsal.—Use Anterior Metatarsal arch support. Fit contour of Longitudinal arch, make transverse elevation just behind location of severe cramps and depressed Metatarsal.

CHART NO. 119
Crosses Point Heads of Metatarsals at Transverse Arch and Cross at Heel Points Tuberosity of Os Calcis. Support Should not be Fitted Beyond the Forward Points.

Callouses On Ball of Foot.—Fit light, springy support and adjust evenly to Plantar surface of arch, with added slight elevation at forward end.

For Painful Heel and for Bursitis, Spur of the Os Calcis, Etc.—Fit arch supports high at weight carrying points beneath Scaphoid and Astragalus, adjusting so that the metal of the support remains one-quarter inch from heel of foot when the support fits all other points of the arch by removing all pressure possible from the Os Calcis.

For Weak Foot With a Tendency of Rolling Outward, a thin wedgelike piece of sole leather may be inserted between the leather and metal part of the support, to prevent the foot from sliding off after regular usual adjustment has been made.

For Foot Strain, causing bodily fatigue, use lightweight foot-eazer. Adjust to fit contour of foot, to relieve ligamentous strain.

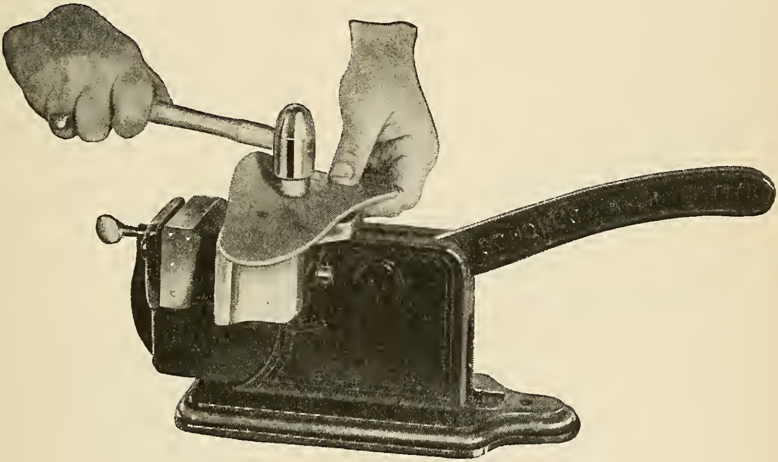


CHART No. 120
Method of Lowering Arch Support to Any Given Point.

Cramped Toes.—Fit lightweight foot-eazer to hold arch in position, to equalize weight and to prevent foot from slipping forward into toe of shoe.

Children's Weak Ankles.—Where weakness is in ankle articulation, fit lightweight support, forcibly correcting condition by well elevating support.

HOW TO MAKE SECONDARY ADJUSTMENT

Since the patient has been properly fitted, and the foot restored to a degree of usefulness and comfort, progressive elevation and correction can be accomplished by having the patient return in two or three weeks for a further and final adjustment. In that way the minor details of adjusting can be carefully followed up, and if there is any slight local irritation the pressure may be removed from the foot in one place and added pressure restored to another, so that a permanent cure may be effected within a reasonable time.

CRYSTALLIZATION OF METALS FROM WHICH ARCH SUPPORTS ARE MADE

One of the difficulties encountered in the construction of orthopedic appliances, and particularly arch supports and those appliances

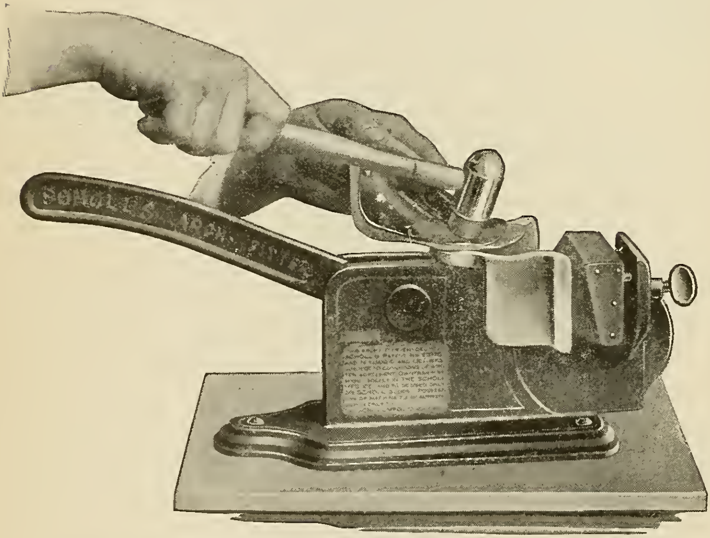


Chart No. 121
Showing How Elevation to Anterior Arch is Made by Placing Over Oval Opening, in Conforming Anvil and Using Rawhide Hammer.

worn inside the shoe, has been to secure a durable, rust-resisting, light-weight metal. Steel is unexcelled for lightness and strength when made of a fine gauge and highly tempered, but will not admit of adjustment. Brass is subject to deterioration, and is very difficult to work up. German silver is most easily worked and fashioned into shape, but is quite heavy, and is subject to crystallization. Other metals are bronze, silveroid, durabellum, magni bronze and hyolite bronze and aluminum. Nearly all these metals are subject to laws of crystallization, and in time will so harden from the constant springing and strain of carrying of one's weight that they will crack and break, and it is advisable to explain this to the patient, as many shoe dealers, chiropodists and physicians are of the opinion that these supports are indestructible.

CHAPTER XXII

HALLUX VALGUS AND BUNION

Hallux valgus is a term applied to a partial displacement or outward dislocation of the great toe at the Metatarso-Phalangeal joint. The great toe is forced outward, sometimes under and at other times

Chart No. 122
X-Ray Showing Bone Displacement in Hallux Valgus.

overlapping the other toes. In its displaced position the cartilaginous surface of the head of the Metatarsal becomes inflamed, which later involves the soft tissue.

This frequently leads to confusion as hallux valgus condition, which is accompanied by enlargement at the great toe joint, seems to be regarded by the public as a bunion, when as a matter of fact

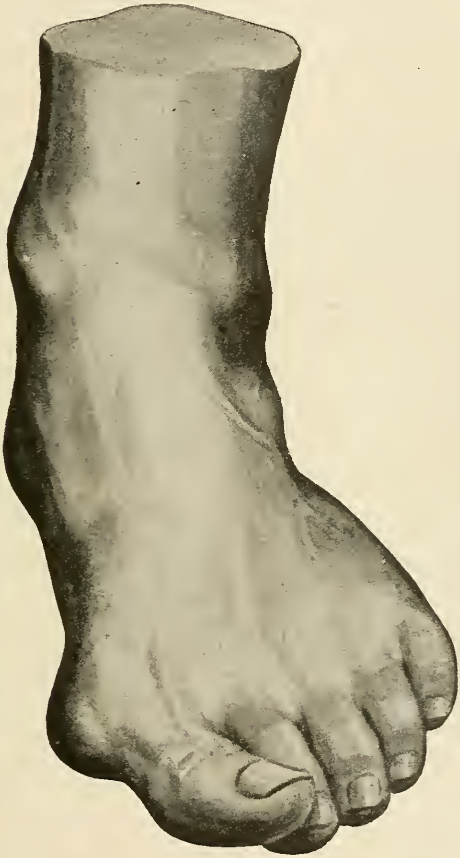


Chart No. 123
Bunion with Hallux Valgus.

hallux valgus, strictly speaking, consists of the deformity of the bone which in severe cases does cause an enlargement at the Metatarso-Phalangeal joint.

Bunion is most generally associated with hallux valgus. Using the public phraseology and definition, a bunion is any enlargement at the first Metatarso-Phalangeal joint. A bunion consists of an inflammation of the soft tissues over the great toe joint, generally producing a bursa. This part is swollen, tender and red, and may even suppurate, the abscess often involving the joint.

In the treatment of foot deformities there is probably no malformation or deformity so easily recognized externally as hallux valgus.

Chart No. 124
Bunions of Long Standing Accompanied with Flat Foot.

There are various causes, but the most marked are mechanical causes, and under this head the wearing of short, pointed toe, narrow, restricted shapes are the most frequent causes, for when pressure is brought to bear upon the foot full expansion is not permitted and the great toe is forced backward and outward. Hosiery worn short and pointed at the toe is another frequent cause. Rheumatism, gout, rheumatoid arthritis, osseo-arthritis also produce a defect. Weak arch and flat-foot condition can be traced in a great number of cases as being the direct cause. The deformity is one slowly produced, over a considerable period of time, and with the first toe is being gradually displaced. The pain is not greatly felt until a new irritation, caused by pressure, brings it to the sufferer's attention. It is not unusual to

Chart No. 125
X-Ray of Bunion Foot After Hallux Valgus Operation Showing Head of First Metatarsal Excised and Second Toe Removed Owing to Underlapped Position.

find the Phalanges in the second toe distorted through crowding upward of the great toe, sometimes under and sometimes over. Corns and callosities very frequently form which become very painful. If the hallux valgus foot is examined with the X-ray it will be found that the first Phalanx is more or less displaced, as also the outer surface of the head of the first Metatarsal bone. It will be found in a position of subluxation, or partial dislocation. The Internal Lateral ligament is elongated and often thickened, and the External Lateral ligament is shortened. Sometimes the inflammation at the point of the deformity may cause suppuration, and an abscess may open externally or into the joint, or into both directions, but this is only found in the most severe and rare cases. In the acquired cases the toe can easily be placed to a straight line with the foot by taking hold of the Distal Phalanx and stretching the toe inward, but in the more severe cases

Chart No. 126
Bunion with Overlapping
Second Toe.

and cases of long standing this is more difficult. There are found persons with hallux valgus which may be traced to hereditary causes. These, as a rule, are not as painful and distressing, except by the annoyance of being improperly fitted with footwear. The deformity is more common in women than in men, probably due to the fact that the shoes worn by women are of a more pointed toe shape.

Treatment.—The treatment indicated in hallux valgus and bunion is usually mechanical. The first essential is to remove the cause. If short stockings, short shoes or pointed toe shoes have been worn replace with the correct styles and sizes. Then the object is to straighten the deformed toe to a straight line of the foot. This, in milder cases, may be effected by use of a spool toe post, known as a bunion-right, or toe flex. These devices are made of rubber and have a top and bottom shield so as to exert a continuous pressure to hold the displaced member to its normal position. These devices are especially essential in the early stages and in those cases that are not flexible and subject to traction. If these devices are worn during

Chart No. 127
Note Flexibility of Same Foot.

the day in a shoe that will permit the straightening of the toe, considerable relief can be secured. For night wear a bunion spring is indicated. By far the most practical that has yet been placed upon the market for the use of the orthopedic operator consists of a spring made of metal, having an oval opening over the enlarged joint, padded with soft felt to relieve it from pressure, and with a means of holding to the foot so as to act as a lever in drawing the displaced toe to a straight line of the foot. The author's bunion spring, such as described above, has an added spring which is attached to the lever with a pivot extending under the ball of the foot, which prevents displacement either in the shoe or, if worn at night, by the bed clothing. This Metatarsal spring by its support offers a means of raising the Metatarsal arch which relaxes the Internal Lateral ligaments. It can be adjusted by lacing, whereby gradual correction can be had. The

CHART No. 128
Toe Flex Placed in Position Bringing Toe to Normal Position and Correcting Overlapping Second Toe.

spring, as described above and illustrated in Charts Nos. 129 and 130, can be worn in a large shoe for day wear, but is most practical for night wear. Where there is considerable tenderness and external pressure produced by the shoe, a shield made of gutta percha or rubber molded to conform to the actual lines of the foot, having a shoulder at the posterior part of the Metatarsus slightly concaved at the forward inner edge so as to allow room for the great toe to assume its normal position, is most efficacious in relieving pain and pressure. Where there is considerable superfluous tissue or enlargement, or local inflammation, or tenderness, this shield, known as bunion reducer, as named by me, will create a mild hyperemia, stimulating circulation and reducing the enlargement. The bunion reducer is worn directly over the affected joint and when fitted properly in that way will not shift out of position. The advantages also in this reducer are in the relieving of shoe pressure and also to maintain the original shape of the shoe so as to hide the deformity. These rubber reducers are

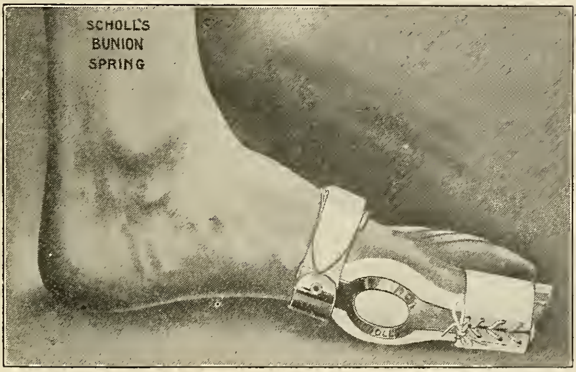


Chart No. 129
Bunion Spring Applied.

made in stock sizes to fit all ordinary cases and can be vulcanized from casts of the enlarged joint in more severe or peculiarly shaped conditions.

In all instances where the Longitudinal arch is weakened, or where the dead weight of the body is thrown upon the first Metatarso-Phalangeal joint, due to weakness or constant use of the feet, an arch support should be fitted to the foot. The springy support of two pieces, allowing free movement anteriorally, should be used, and in the adjustment it is advantageous to posterially lift the enlarged joint. It should be borne in mind by the practitioner that relief is the essential thing to consider, and frequently the foot-eazer, fitted to support the arch, will give immediate relief. Toe-free hosiery is

Chart No. 130
Top View of Bunion Spring in Position.

also indicated. In the more severe cases surgical operation must be resorted to if correction of the deformity is desired.

Chart No. 131
Rubber Bunion Reducer Applied to Foot.

FELT PADDING

Concaved pads of felt, smoothly skived, that can be placed about the affected area to remove pressure, are very useful and frequently used by those who have the deformity of long standing, as well as the hereditary cases, and where there appears to be but little mobility in the joint. The object of the pad is to relieve pressure of the

Chart No. 132
Skived Kiro Pad for Bunion Joint.

shoe. Kiro pads are most useful for the practitioner, inasmuch as they are automatically skived by patented process, leaving the inner surface concave to fit the foot externally and shaped so as to admit the wearing of the usual shoe. Another means which I have used very successfully, and which is desirable in the extremely prominent

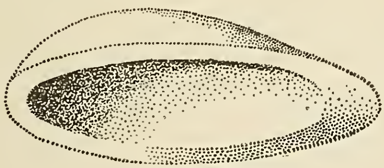


Chart No. 133
Skived Concave Kiro Pad.

joint where bunion growth is apparent, is the method of padding the inside of the shoe with specially shaped pads known as Strait-Shu Bunion Pads. Two pads are necessary, one behind the bunion, which is longer and thicker, although concave, and the forward one, which is shorter and thinner and convex. They are applied by a suitable

Chart No. 134
Kiro Pad with Thick Shoulder and Center Opening.

Chart No. 135
Kiro Pad with Shoulder Behind, Enlarged Joint.

adhesive which must be moisture-proof and are placed in position in the inside lining of the shoe so that the enlarged joint positions itself between the two pads. This method has been so successful

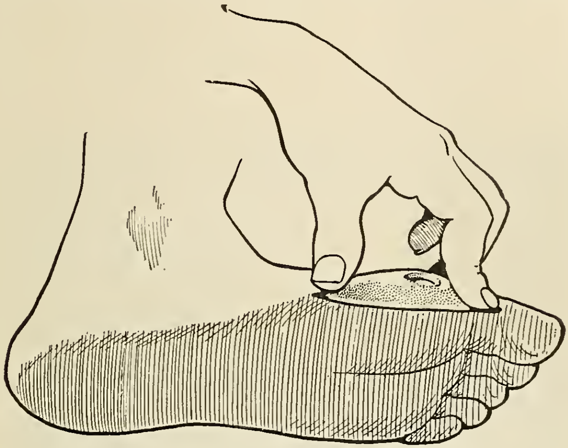


Chart No. 136
Kiro Pad Applied Over Bunion Joint.

that many patients have their shoe dealer affix the pads to each pair of new shoes.

Medical treatment consists of applying Wenal, which can be followed by cold applications; wet dressings, hot boric poultices, oint-

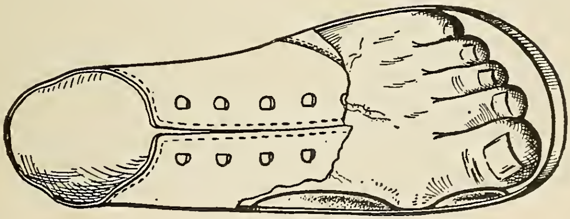


Chart No. 137
Strait-Shu Bunion Pads Attached to Inner Lining of Shoe.

ment, etc., are frequently used with a purpose of alleviating the pain. Felt rings or washers, plasters, etc., should be avoided as they only tend to aggravate the condition.

TREATMENT OF BUNION

Bunion is so frequently associated with hallux valgus, as previously stated, that it becomes necessary to describe treatment for this inflammatory condition in conjunction with the foregoing. Remove pressure of the shoe and, if very badly inflamed, give absolute rest

Chart No. 138
Bandaging After Kiro Pad Has Been Applied.

to the foot by elevating same after a warm foot bath. Then apply Wenal ointment to the parts. The following day soft felt Kiro pads are applied until all inflammation desists. Should there be any suppuration or abscess, same should be treated surgically.

CHAPTER XXIII

HALLUX RIGIDUS OR PAINFUL GREAT TOE—HALLUX VARUS OR PIGEON TOE

HALLUX RIGIDUS OR PAINFUL GREAT TOE

Painful Great Toe is also known as flexus, hallux rigidus and hallux dolorosus. This condition of painful great toe is attended with great pain in the first Metatarso-Phalangeal joint, and consists of ankylosis of the Metatarso-Phalangeal joint of the great toe. When the toe is moved external inflammation appears. There is but slight rigidity, but considerable pain and occasionally slight swelling. This

Chart No. 139
Painful Great Toe with Weakened Arch.

is invariably caused by a condition of flat-foot, incipient flat-foot, or with shoes that are fitted too short, but is sometimes caused by an injury to these parts. A weakened foot elongates and slides forward into the toe of the shoe, which doesn't permit the foot to stretch out to its entire length, creating an inflammation at the Metatarso-Phalangeal joint. This condition is most frequently found in growing boys and girls and it can be detected by movement of the great toe and by careful examination for weak flat-foot.

Treatment.—Fit the Longitudinal arch to an arch support or foot-eazer, so that the Longitudinal arch will have an even bearing at all points, the object being to remove the pressure on the painful joint and to restore the natural motion of the foot, removing muscular and ligamentous strain, also the pressure of the body's weight at the affected joint. These conditions should be handled in the same manner as weak foot or incipient flat-foot. Care must be taken that the shoe is of sufficient length and no restricting action produced by the stocking.

Where considerable pain is present, a stiffening device should be inserted between the soles of the shoes.

HALLUX VARUS OR PIGEON TOE

Hallux Varus is also known as pigeon toe. It is of little importance and usually congenital in origin. Occasionally it may be seen

Chart No. 140
Showing Method of Wedge Leather Application to the Sole for Pigeon Toe.

in children with flat-foot, also in cases of overcorrected club-foot, usually resulting in valgus.

It consists of a toeing in or abnormal adduction of the great toe.

While in pigeon toe an adduction of all the toes is present, it is mostly congenital and in the latter it is generally due to a rotation of the entire limb while in the former the great toe seems to be relaxed, allowing it to adduct. At times it has been found in connection with severe cases of knock-knee.

Treatment.—While bandaging in the opposite direction of the deformity can be used with considerable aid in the early stage, from my observation I find that by adding to the outsole of the shoe a triangular-shaped piece of sole leather on the inner side from a line drawn at the center of the sole of the shoe to just behind the ball definite results will be obtained. (See Chart No. 140.)

CHAPTER XXIV

PAINFUL HEEL

As a rule, pain and tenderness in the heel are caused by bruise, pressure and strain directly brought on by overuse of the feet. It is also frequently found among persons who do constant standing or walking, and who are developing a condition of flat-foot. This painful condition is frequently known as policeman's heel. Again the pain

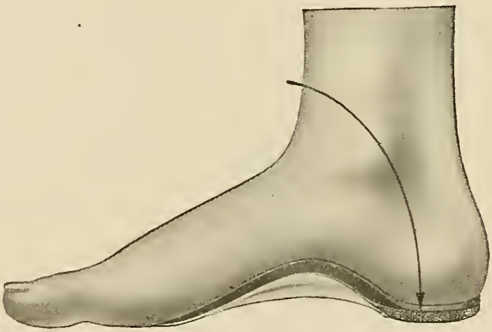


CHART No. 141
Arch Support or Foot Rest in Position.
Sponge Rubber Pad Beneath Heel.

is produced by inflammation of the Calcaneal Bursa, which is known as bursitis. There are other cases where the pain and disturbances are caused by growth or spur on the Os Calcis, and in any of these cases, whether from the last mentioned causes, or which may be verified as a symptom of weak or broken-down arch, examination of the foot should be made the same as for flat-foot or arch trouble to learn whether the pain is caused by flat-foot condition.

Treatment.—The first necessary element is to relieve the pressure on the Os Calcis or heel. This is best done by fitting the patient to a pair of arch supports, taking special care to remove all pressure from the sensitive, painful area, which is best done by the Tri-spring arch support as illustrated. Supports should be elevated posterially to remove the pressure, and whether the pain is caused by oncoming flat-foot, by foot strain, or is the result of inflammation of the Bursa, or caused by the irritation produced by the growth, this method will give relief. Pads of soft felt, sponge rubber, etc., hollowed out to receive the heel, have also been used but not with such marked success.

In fitting the arch support, care must be taken to fit the support so that the plate part exending under the heel remains away from

Chart No. 142
Korrecto Arch Support Fitted to Relieve Painful Heel.

the Os Calcis so that the actual bearing point comes forward. (See Chart No. 143.)

Achillotenontitis is an inflammation of the tendon itself or its sheath. The lower part of the tendon is abnormally enlarged and tender. Bandaging with pads on either side of the tendon is beneficial, although arch supports fitted to remove excessive pressure should be advised. Rest is also very effective. Climbing of stairs should be avoided.

Talagia and Osteophytes of the Os Calcis.—The Os Calcis is not infrequently the seat of tuberculous disease and must be treated as a tubercular affection, also frequently the seat of gonorrheal infection, when it is often enlarged and tender to lateral and plantar pressure, a painful point over the tuberosity of the Os Calcis persistent and troublesome. Skiagraphy shows that the cause is frequently irritation and osteophytes, and on their removal disappears.

This tender heel has been called Bursitis, and is probably due to a bursitis. It is usually an accompaniment of flat-foot, due to the

Chart No. 143
Tri-Spring Arch Support Fitted to Relieve Painful Heel.

irritation at the insertion of the Plantar ligaments. When this condition is caused by gonorrheal infection, the trouble is often diffused through the Tarsus, or causes swelling and tenderness about the Astragalo-Scaphoid joint. Strains and wrenches of the foot frequently result in acute tenosynovitis of the Extensor or other tendons. The tendons affected are swollen and motion is very painful. Rest, tincture of iodine applied locally, bandaging and the application of an arch support which has been fitted to the Plantar arch so as to remove pressure from the heel usually effect a cure in a short time. Injuries of the foot, when accompanied by much ecchymosis or pain at a definite point, should be skiagraphed to ascertain if a fracture is present.

CHAPTER XXV

HAMMER TOE

Hammer Toe is a contraction of one of the toes, usually the second or the third. The condition is one of flexion of the second Phalanx with extension of the third, causing the pressure on the ground to be sustained by the Distal Phalanx. There is a complete or partial contraction of the ligaments, and the controlling muscles are also

CHART No. 144
Foot Showing Hammer Toe—Second Toe.

sometimes involved. A callous and corn are usually found over the upward projecting joint, which may cause considerable annoyance. The deformity may be congenital but in the milder forms it is acquired principally by narrow, short shoes. In the early stages little difficulty is experienced by the patient. However, later locomotion is difficult and painful. In all but the most severe cases the deformity can be corrected by simple mechanical treatment.

CHART No. 145
Hammer Toe Spring Adjusted to Toe and Foot.

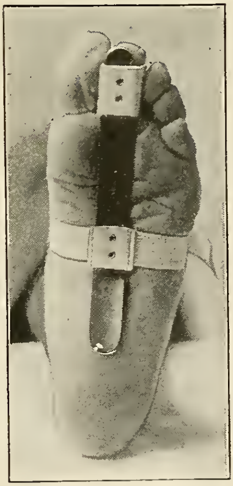


CHART No. 146
Bottom View of Hammer Toe Spring.

If the case is not of too long standing, the hammer toe spring will be found of special benefit, and will gradually straighten the toe. Author uses two patterns of this spring—one with extension under the Plantar surface of the foot to give added correction, while the other is made with a short spring having a loop for the toe or toes as shown in the illustrations. (See Charts Nos. 146 and 147.) When

CHART No. 147
Spring for Hammer Toe,
Short Spring.

more than one toe is affected a special hammer toe plate with straps going over and between the toes is used. Kiro or absorbo pads, to relieve the pressure of the shoe from the apex of the contracted joint, are also beneficial, affording relief from pain and discomfort.

A contracted position of several toes is often encountered, which is usually due to improper shoes or the result of previous paralysis of some muscles of the foot. It is also found in connection with the condition spoken of as contracted foot.

The tendons and fasciae are found to be shortened. This deformity may be treated in the same way as a contracted toe. Properly made shoes in an affection of this kind should be as in all other deformities.

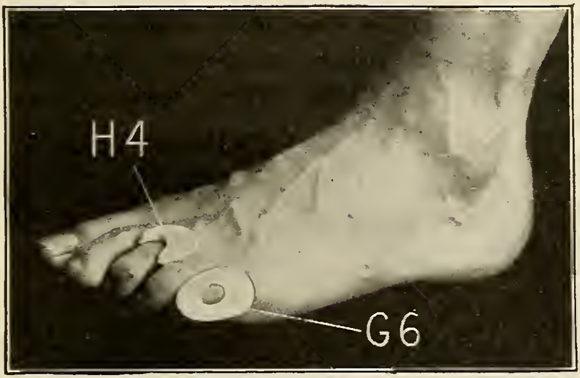


Chart No. 148
Kiro Pads for Hammer or Contracted Toe.

OVERLAPPING TOES

Very common among adults. Owing to the pressure of narrow shoes, we find a condition of overlapping toes. Not infrequently deformities of this kind are seen in infancy and are apparently congenital. The greater number, however, are acquired. Deflected or deformed toes may be treated by manipulation and by supporting with toe flex, or toe-right, or with strips of adhesive plaster. In severe cases the hammer toe spring or special plate should be used. Care should be taken to avoid crowding the toes into shoes of insufficient length and width. This deformity, acquired in childhood, usually can be corrected with exercise and proper shoes.

CHAPTER XXVI

WEAK ANKLE—SPRAINED ANKLE—TUBERCULAR ANKLE

WEAK ANKLE

Weak Ankle (In Ankle) is a posture of weakness in which the Inner Malleolus descends and becomes prominent. It is often associated with the out-toeing, abducted and everted foot, and also with knock-

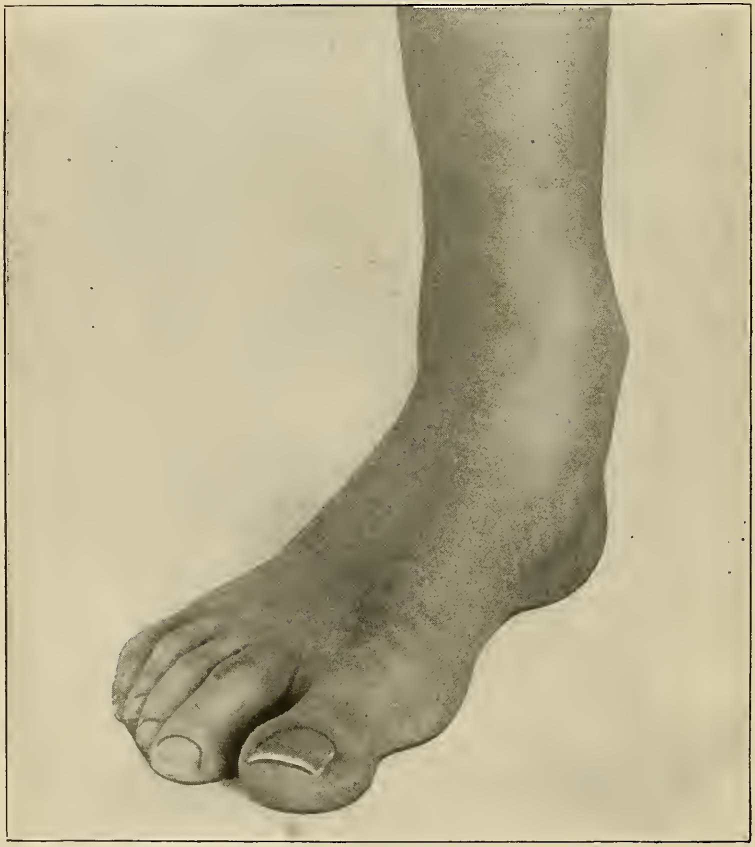


Chart No. 149
Showing Bulging Ankle and Rotation of Inner Malleolus.

knee. Very frequently weak arch or flat-foot is diagnosed as weak ankle. The weakness usually occurs at the junction of the Inner Malleolus and Astragaloid region. There is a relaxing and stretching of the ligaments, which permit an inward rotation as the weight is transmitted into the foot. The treatment is that of weak-foot, giving mechanical support to the Plantar arch directly beneath the Inner Malleolus. Weak ankle is very frequently found among children, and is associated with flat-foot. Adhesive strapping, stiffened shoe counters, elastic bandages and corset ankle supporters are also used. The author's method is to give mechanical support to the Plantar arch—ankle articulation. (See Treatment of Weak Foot—Chapter XVII.)

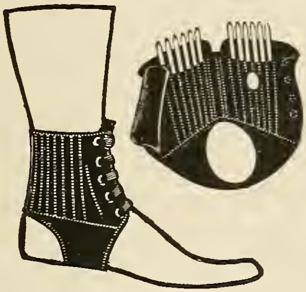


CHART No. 150
Ankle Support for Children.

SPRAINED ANKLE

Sprain of ankle is a common injury, which consists in the rupture of some of the fibers of the lateral ligament, usually the external of the ankle joint. It is a result of direct or indirect violence which may rupture or tear the ligaments. Swelling, pain, tenderness, disability and ecchymosis follow rapidly upon the injury. Recovery under local applications or plaster of paris splinting is slow. If severe, the patient should be made comfortable and the foot elevated to a position of absolute rest, with applications of cold and warm water alternately. Ligtone, arnica or other evaporating lotions may be used. Then the foot and ankle may be strapped with adhesive and firmly supported to prevent any further strain. Wearing an arch support in the shoe after it has been properly fitted will be found a great aid. Soreness and lameness may persist for months. In injuries with great ecchymosis, fracture of the tip of the Malleolus should be expected and a skiagraph taken.

TUBERCULOSIS OF THE ANKLE

Tuberculosis of the ankle occurs usually as an infection from one of the neighboring bones, especially from the Astragalus or lower end of the Tibia.

In children this disease often recovers under immobilization of the foot and ankle, with an ankle brace, or with gypsum splint, and suspension of the limb by crutches, or a Thomas splint, and the usual tonic treatment for tubercular affections.

In other cases sinuses will appear which may heal under simple aseptic dressings or the injection of a saturated solution of iodoform in ether, or the bismuth vaseline mixture. Sometimes the ankle joint has to be opened and the diseased tissues removed, including the original focus. This often involves the removal of the Astragalus.

The location of the bone disease may be determined by skiagraphy.

It is very important that the orthopedic operator make careful diagnosis of tubercular ankle as it sometimes has the appearance of flat-foot or other common foot deformities.

CHAPTER XXVII

TALIPES OR CLUB-FOOT

Is a deformity characterized by an inversion, torsion and depression of the front part of the foot, with an elevated heel. In walking on a foot deformed in this manner the weight of the body is not borne

Chart No. 151
Talipes Varus.

by the sole of the foot, but by the outer side, and in extreme cases by the dorsum of the foot.

There are four varieties of club foot, but in any case the foot is twisted out of its natural shape and an actual deformed condition exists. The varieties are:

Talipes Equinus, where the heel is elevated, foot extended and the patient walks on the balls of the toes. (See Chart No. 153.)

Talipes Varus, the inner side of the foot raised and adducted so that the weight falls to the outside portion of the foot.

Talipes Valgus is just the reverse of Talipes Varus, the foot being abducted so that the weight falls on the inner portion of the foot.

Talipes Calcaneus, the toes are raised and most weight is carried on the heel.

It may either be congenital or acquired.

The tissues are all necessarily affected by the abnormal position, and the skin, muscles, tendons and fascia are all altered.

In congenital cases of club-foot, even in cases at full term, the Scaphoid articulates with the side of the head of the Astragalus instead of with the anterior surface. The articulation is also more towards the underside of the Astragalus, the head being uncovered.

The Scaphoid may be displaced to such an extent at one side as to articulate at one end with the tip of the Internal Malleolus. The distortion in the shape of the bones in infants is of little importance, as the ends are largely cartilaginous. The Tarsal bones, however, are not in a normal position. As the Cuneiform bones are intimately connected with the Scaphoid, it is also displaced, the same being true of the Metatarsals and the Phalanges. The long axis of the front part of the foot forms a right angle, sometimes an acute angle, with the axis of the leg. The Cuboid is also displaced and does not articulate with the front of the Os Calcis, the Facet also inclining obliquely to the inner side.

In cases that are fully developed, and in older children or adults, there is a marked alteration in the shape of the bones. The bones noticed to have been altered in shape and position are the following, viz., the Os Calcis, Cuboid, Astragalus and Scaphoid.

By the elevation of its tuberosity the Os Calcis is drawn from a horizontal into a position nearly vertical. It is more or less rotated on its vertical axis, its anterior extremity being directed outward and the posterior extremity inward, this causing the anterior articulating facet to be oblique to the axis of the bone.

The connection of the Cuboid with the Os Calcis remains, but follows the inward direction of the anterior extremity of the foot.

The Astragalus does not rotate on the vertical axis, but is depressed forward on its horizontal axis so that only the posterior portion of its superior articular surface is in contact with the inferior articular surface of the Tibia, the anterior part of its anterior facet projecting beneath the skin of the Dorsum of the foot. Other than the displacement previously mentioned, it is altered by the twisting

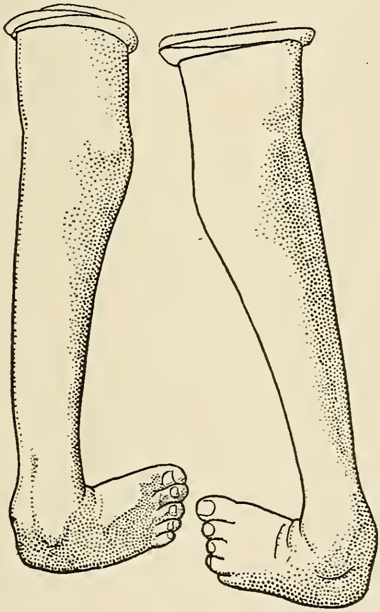


Chart No. 152
Double Talipes Varus.

inward of the head and neck, so that the anterior articular surface looks inward instead of forward, and the disposition of the cartilage at the articulating surface of the head of the Astragalus is necessarily altered. The three Cuneiforms and the three Metatarsal bones being closely connected with the Scaphoid, are more twisted to the inner side than is the case with the Cuboid. The Metatarsals are not all alike involved in the rotation from without inward, and are spread out in such a way that the anterior part of the foot is abnormally enlarged. There are other alterations in the position of the foot which take place, due to pressure and the effect of locomotion on the distorted bones. The different tendons take an abnormal direction and in general are carried farther to the inner side than is normal, especially that of the Tibialis Anticus, which is the common extensor of the toes and the long extensor of the great toe.

Synovial Bursae may form on the outer edge and back of the foot, which at times become inflamed and purulent. There are often corns and callosities present on the skin, due to the pressure from walking.

In cases of club-foot no changes have been as yet found in the nerves or spinal cord.

In severe cases there may be slight alteration in the shape of the Femur and a laxity at the knee joint. The Tibia and Fibula have been found altered. In congenital club-foot the muscles are never paralyzed, but the contracted muscles appear more developed than the lengthened ones. From disuse the muscles of the leg atrophy, consequently making the leg smaller and the foot shorter than normal.

There is also a change in the ligaments and fascia, not confined to the severe and older cases but always present. The ligaments and fascia affected by contraction are the Plantar ligaments and fascia, the internal, lateral and posterior ligaments.

Causes.—Club-foot is usually a congenital deformity, but it can also be acquired after the impairment of muscular power, such as in paralysis, and after accident.

The chief theories advanced in explaining the origin of club-foot are as follows:

1. Abnormal compression while in utero.
2. Retraction or paralysis of muscles, depending or not on lesions of the nervous system occurring in utero.
3. A malformation depending upon arrest of development of the foot.

Diagnosis.—In walking, club-foot causes great inconvenience to the patient, although in uncorrected cases skill and agility of locomotion are acquired even though the deformity remains unchanged. Discomfort is also occasioned by the formation of bursae and callosities which inflame over the unprotected portion of the foot, limiting the patient's amount of activity.

The distortion presents an inward twist of the foot, with a depressed position of the outer edge. To the touch the Tendo-Achillis is firm and hard; the Plantar fascia will also be found short and hard on palpation. (There is a projection on the inner side of the vertical axis of the leg, the fore part of the foot.) The fore part of the foot projects to the inner side of the vertical axis of the leg, the tendinous end of the Os Calcis being raised and turned inward.

The head of the Astragalus and Cuboid project under the skin, and there is usually an atrophy of the muscles of the leg. There is a prominence of the External Malleolus, while the internal cannot readily be felt.

Club-foot is readily recognized.

By obtaining a history of the case, diagnosis can be established between the congenital and noncongenital forms of club-foot. Paralysis is the only common cause of acquired club-foot, and it can be recognized by the evidence of paralysis of the muscles on the anterior and external surface of the leg.

The deformity will not correct itself, and if left uncorrected remains the most obstinate of malformations.

If skilled care and attention is given, the deformity is said to be always curable.

Treatment.—Treatment of club-foot varies according to the patient and the duration and nature of the deformity.

The treatment should be purely mechanical, or operative and mechanical.

The object of treatment is to correct the distortion and to retain the foot in a correct position until any return of the deformity is impossible.

Specially made braces of a scientific corrective nature, when applied to the child, will do much in assisting toward a cure. Shoes built with a corrective object in mind also aid, although in the adult shoes and braces can only add to the comfort and possibly remove undue and uneven pressure.

TALIPES EQUINUS

Is the name given to a condition in which the foot is held in a position of Plantar flexion, and rendering Dorsal flexion to the proper extent impossible. It is known also as pes equinus and horse heel.

It is very rarely a congenital deformity but, as an acquired one, it

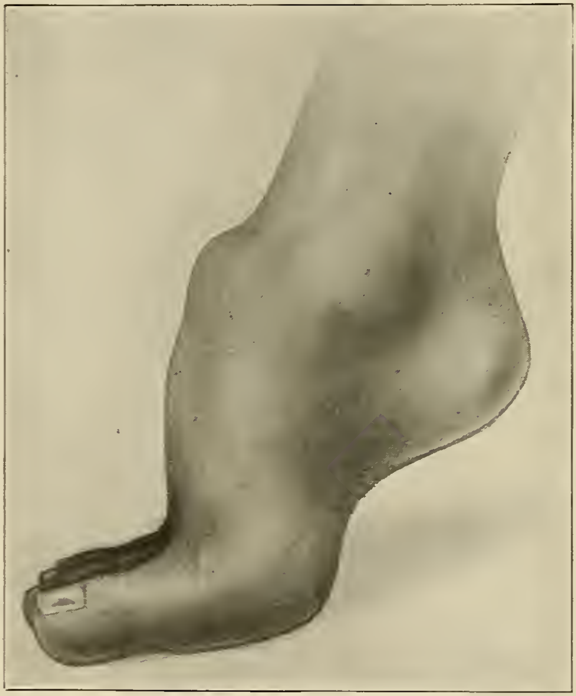


Chart No. 153
Talipes Equinus.

is very common, especially in its milder degree. In the acquired form all degrees are encountered, from a condition in which the foot cannot be flexed beyond a right angle to one in which the foot and leg are nearly in a continuous line.

In milder forms the deformity is of less importance than other forms of talipes.

This affection in a light degree may cause a person to limp in walking, because in carrying the leg back at the end of the step the foot must be bent more than to a right angle.

The changes of the structure in talipes equinus are slight. In many cases there is a shortening of the Tendo-Achillis and a consequent alteration in the shape of the bones of the foot.

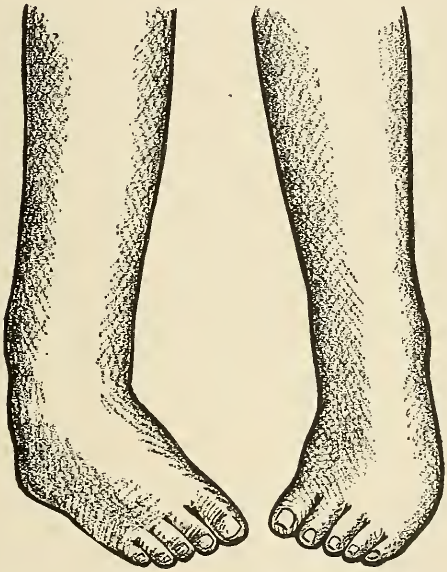


Chart No. 154
Mild Case of Talipes Varus.

The increased depth of the arch or cavus is primarily due to a falling downward of the fore foot at the Medio-Tarsal joint, in fact in many cases it is due more to the former than to the Plantar flexion of the Calcaneum.

Equinus in the lighter degree is the most common of the forms of talipes acquired in later life. Although anterior poliomyelitis is the cause most common, it is not as important in the etiology of this as of other varieties of deformity.

The detection of talipes equinus is so simple that it requires no description.

Contracted Foot (Non-Deforming Club-Foot.)—This form, which is a slight degree of talipes equinus, deserves a separate consideration. It is characterized by a moderate degree of limitation of normal dorsal flexion of the foot. It is known under the name of "non-deforming club-foot," and also as "contracted foot." It is due to a contraction of the posterior muscles of the leg, principally the Gastrocnemius, or the muscles of the sole of the foot. It may occur in flat-foot, the weakened foot, and in like conditions in which it is probably due to irritation and possibly reflex in character.

It is frequently associated with Metatarsalgia, possibly as the cause or as the result of irritation from the foot. It is often seen in sciatica, when flexion of the foot beyond a right angle is restricted and very painful. Sometimes cases are encountered in elderly persons, due to a stiffening and loss of elasticity in the posterior muscles. Occasionally it exists in hysterical persons, more often in women, with other obvious causes. In adults and children apparently in perfect health, with no demonstrable cause, it is often noticed, also after sprains of the ankle.

TALIPES VARUS

Or sometimes called Equino-Varus, is a common form of congenital club-foot and is sometimes accompanied by other congenital defects such as hare lip.

TALIPES VALGUS

This is the condition of the foot abducted and everted. The side becomes flattened and the inner border comes in contact with the ground. Considerable pain is experienced after walking a short distance. This deformity is occasionally due to absence of the Fibula. The acquired variety, which is not uncommon, results from paralysis of the Tibial muscles or from spastic contraction of the Peronei, the condition and appearance closely resembling flat-foot.

TALIPES CALCANEUS

Is a condition in which the foot is held in a position of dorsal flexion. It is much less common than equinus, and usually of paralytic origin, although cases following injury or disease, or distortion, are occasionally encountered. There are several varieties of the deformity. It may exist alone or associated with valgus, in which case it is known as talipes calcaneo valgus. Occasionally it exists as a congenital deformity in a varying degree. At times only a slight prominence of the heel is noticed, when at others it may be so severe that the Dorsum of the foot is almost against the shin.

Acquired talipes calcaneus is most often the result of paralysis of the muscles of the calf of the leg, due to anterior poliomyelitis. It also occurs in chronic diseases of the ankle as a result of muscular irritability, from rupture or division of the posterior muscles of the leg, and from anterior cicatrices. Sometimes it exists in hysteria.

On inspection the deformity is readily noticed and, as the name implies, the patient walks on an elongated heel.

CHAPTER XXVIII

PES CAVUS—HUMP-FOOT—HOLLOW CLAW-FOOT

PES CAVUS OR HOLLOW-FOOT

In this deformity the anterior part of the foot is drawn backward and the arch increased. The Plantar arch is increased in height and greater weight is placed upon the Metatarsal bones and posterior tuberosity of the Os Calcis. All degrees of severity are encountered.

Chart No. 155
Pes Cavus or Contracted Foot.

In some cases the ball and heel of the foot are in contact, the arch being converted into a deep sulcus or groove. There are three forms of Pes Cavus which are recognized. The first is due to the contraction of the Peroneus Longus and the deformity resulting.

The second is the result of paralysis of the Gastrocnemius and Soleus muscles, the sole of the foot is lowered, and by the action of the long flexors on the anterior part, a cavus foot is developed. In addition to this there may be Varus, or Valgus distortion.

The third form may be acquired but is usually congenital. This condition is due to a marked depression of the heads of the Metatarsal bones with a forced extension of the first Phalanges and a flexion of the last.

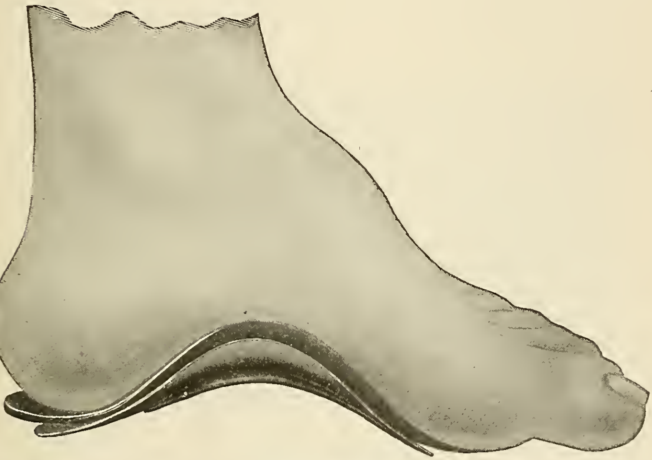


Chart No. 156
Showing Tri-Spring Arch Support Fitted High into Arch for Pes Cavus.

Paralysis of the Interossei and Lumbricalis muscles, and of those muscles inserted into the Sesamoid bones of the great toe, is the origin of this affection.

Frequently the ligaments are contracted and cause a clawing upward of the toes. With the contracted foot, corns and painful callouses form at the ball of the foot and occasionally about the heel.

To correct this deformity with mechanical appliances is very difficult. Braces, however, that will give support and restore balance to the foot and weight carrying points can be made good use of with satisfactory results. Where the toes are badly contracted in the form of hammer toes, a hammer toe plate or spring should be used to assist in straightening the same. The object is to build up the deficiencies and lessen the pressure and bearing points in all parts of the foot.

HUMP-FOOT

Flexion at the first Metatarso-Cuneiform joint, with enlargement of the bones on the Dorsal surface, causes a deformity known as hump-foot. Short shoes with high arch and tight vamp produce this

Chart No. 157
Hump-Foot, with Metatarsalgia.

condition. This affection is often very painful, and can be relieved by wearing proper shoes, rest, and the applying of absorbo or kiro pads to prevent further pressure or friction of the shoe.

HOLLOW CLAW-FOOT

In hollow claw-foot there is a cavus combined with hyperextension of the proximal and flexion of the other segments of the toes. This condition is frequently associated with paralysis of the Interossei and Lumbricales. The affection is very similar to Pes Cavus and the same treatment must be used.

CHAPTER XXIX

KNOCK-KNEE—BOW-LEGS—DEFORMITIES OF THE KNEE

KNOCK-KNEE

Knock-Knee (In-Knee, Genu Valgum) is a deformity where the knee is thrown inward, a perpendicular line drawn from the head of the Femur to a point midway between the Malleoli. There is an outward curve with the bones of the thigh and leg which may occur in one or both limbs.

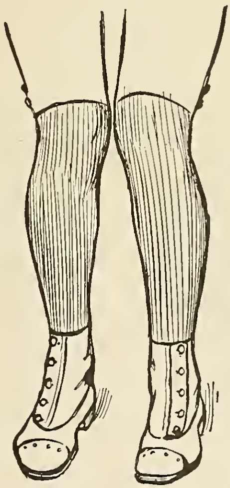


Chart No. 158
Knock-knee Condition in a Boy.

This deformity is usually due to rachitis, but the mild grades may be the cause of static conditions in delicate or otherwise normal children. It also may be due to other causes, also frequently found associated with flat-foot which is a predisposing cause, and often follows tuberculosis of the knees and infantile paralysis. Knock-knee usually manifests itself in children of the age between two and four when commencing to walk. It often occurs in adolescents who stand too much on their feet or carry heavy loads and consequently require supporting of the arch. The deformity is principally in the Femoral Condyles, or at the upper end of the Tibia, or alike in both. Upon

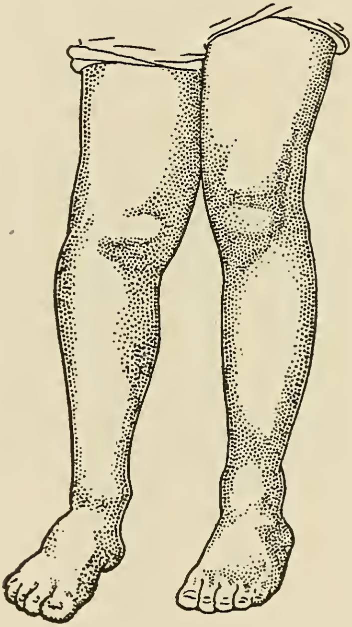


Chart No. 159
Knock-knee.

flexion of the knee, knock-knee may disappear. Due to stretching of the Internal Lateral ligament the knee is somewhat loose, then being turned out unless instinctively turned forward or in as a protection to the weak inner side of the knee. Mechanical braces are indicated that will afford proper amount of correction in drawing the limbs to a straight line.

Knock-Knee with Weak Foot.—Regularly weak feet are found with rachitic and static knock-knee aggravating the difficulty. Knock-knee is usually bilateral, although it may occur on one side only, or be paired with a bow-leg on the opposite side. An anterior curvature of the Tibia is frequently found with knock-knee. Knock-knees and bow-legs have been often found to exist in the same individual, and also combined with anterior curves of the Tibia and of the Femur. In walking with knock-knees the knees rub together and the feet are not properly placed, occasioning a stiff and awkward gait. In extreme cases walking is almost impossible.

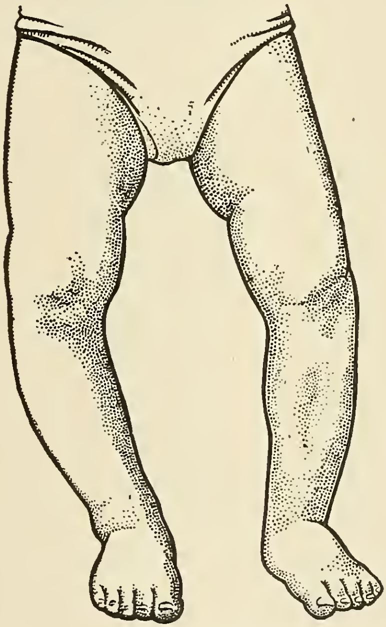


Chart No. 160
Bow-legs in Child.

BOW-LEGS

Bow-Legs and Genu Varum or out-knee is the opposite deformity to knock-knee. The knee, by bending of the Femur or Tibia or both, is carried outward or by a deformity of the Condyles of the Femur or Tibial tuberosities. This deformity may be caused by injuries with outward displacement of the knee, or followed by a gradual yielding due to insufficient stability. There is also a paralytic genu varum due to relaxation of the External Lateral ligament of the knee from continual strain. The cause most common is due undoubtedly to rickets, and the yielding is usually most below the knee, which is the usual bow-leg deformity.

The greatest bending may take place below the Tibial tuberosities or at the junction of the middle and lower third.

Chart No. 161
Bow-leg Brace with Thigh Straps.

DEFORMITIES OF KNEE

Congenital Deformities.—Congenital flexion is a condition noticed in babies, occurring on one or both sides. In the light and middle cases it yields to daily stretching.

The more severe forms may be associated with pes calcaneus, and at times are very resistant, requiring tenotomy (the section of a tendon) of the ham-strings, forcible stretching and retentive apparatus.

A snapping or clicking knee is very often seen in young babies. The ligaments appear to be lax, which frequently permits a partial dislocation of the Tibia outward. This condition may be a congenital one, and is usually overcome by bandaging, strapping or mechanical appliances.

Congenital Hyperextension of the Knee (Congenital genu recurvatum; Congenital absence of the Patella; Congenital dislocation of the Knee).

In affections of this kind the baby is usually born breech first, thighs being flexed on the abdomen, the knees hyperextended and the feet beside the face; unilateral cases also occur. This deformity is due to uterine pressure on the extended knee or knees; at times there is ligamentous laxity of a number of joints. The Tibia is displaced forward on the Condyles and the knee lax, allowing lateral and sliding movements. The Patella in the first few months is not felt, but it can be usually before the first year, although it may remain very small.

The hyperextension of the knee is often considerable, and it may be impossible to bring the leg back beyond a straight line. Popliteal creases may not be absent, while creases in front of the knee may be. The Condyles of the Femur are abnormally prominent in the Popliteal space. In cases of this kind the legs must be held in position and gradually flexed, by strapping the patient to a frame, bent under the knees or by other appliances, otherwise the patient will experience difficulty in walking and have loose knees. This condition rarely causes knock-knee. If extension and displacement is prevented and the flexion gradually increased, the deformity may be overcome after a few months, during which time a joint supporting appliance should be worn, the condition then becoming practically normal.

Acquired Deformities.—Acquired genu recurvatum is caused by stretching of the Posterior ligament of the knee joint when motion is not sufficiently checked by the ham-string muscles. In a mild form it is seen in delicate children and also is common in inveterate pes equinus and equino-varus; also after poliomyelitis affecting the knee flexors, especially when the heel cord is contracted. We frequently find occurrences of genu recurvatum in the hypotonus of locomotor ataxia and of coxitis, especially in the latter affection if traction is made from adhesive strips applied only below the knee and when hyperextension is not prevented by a steel band behind the knee. In the paralytic forms and in that complicating locomotor ataxia, an apparatus to prevent lateral motion and to keep the knee slightly

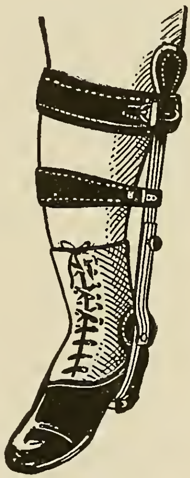


Chart No. 162
Bow-leg Brace Extending to Knee.

flexed should be adjusted. In the rachitic form the bending is usually below the knee.

Bursitis About the Knee.—It is necessary to have a knowledge of the location of the bursa about the knee in order to differentiate knee affections and to apply proper treatment. It should be remembered that by repeated trauma a bursa will be irritated and is liable to the various infections to which serous membranes are subject.

Prepatellar Bursitis or Housemaid's Knee.—It is frequent in those people who work in a kneeling posture and due to the pressure. It appears as a large, rounded, tense swelling in front of the Patella, and usually is filled with a gelatinous fluid, sometimes suppurating.

Pretibial Bursītis.—The Pretibial Bursa lies between the front of the Tibia and the Ligamentum Patella. When distended it projects either side of the latter and appears as a tense, elastic or fluctuating swelling. In diseases of the knee joint it is often affected, but it often is involved without affecting the knee. If filled with pus it should be evacuated, disinfected and scraped, otherwise rest and strapping are usually enough.

Hypertrophied synovial fungi below the Patella may also cause enlargement on either side of the Ligamentum Patella.

Pretubercular Bursitis.—There is, in some individuals, located in front of the Tibial tubercle a small bursa which, after injury or otherwise, may become inflamed and give rise to a small tense swelling which may be unilateral or bilateral, often causing pain, especially in climbing stairs. This condition at times is very persistent, giving rise to a permanent enlargement of the tubercle. Painting with iodine, strapping and rest usually afford prompt relief. Many of these cases in adolescents are due to a diastasis or fracture of the tubercular epiphysis (Osgood), a narrow tongue of bone jutting down the upper Tibial epiphysis. After a fall or a blow in cases of this kind, pain, swelling, tenderness and disability about the Tibial tubercle comes on suddenly.

The bursa under the ham-string tendons sometimes becomes distended or inflamed and may require tapping and compression or more vigorous treatment.

ACCIDENTS TO THE PATELLA AND ITS LIGAMENTS

Slipping Patella.—The Patella after once being dislocated may acquire the habit of slipping, usually to the outer side. This often occurs in knock-knee, and it is usually sufficient to correct the deformity. When it is due to other causes it usually requires a surgical operation, which will be unnecessary to explain here.

Tuberculosis of the Patella.—The Patella is often diseased in tuberculosis of the knee, but there is a probability that the process may begin in the Patella. To recognize this condition early is very important, as a scraping operation or a dissection of the Patella if needed, when performed in time, will often prevent infection of the joint.

The symptoms are pain in and swelling in front of the Patella, which may contain serum, with flocculi and tuberculous debris. By feeling the anterior surface of the Patella you may find it eroded, or erosion may be revealed by a skiagram.

Ankylosis of the Patella.—After an infection of the knee joint the Patella may become united to the articular groove of the Femur. If it has become ankylosed while the knee joint was flexed it stops

Chart No. 163
Tubercular Knee.

extension and its adherence in any position removes all voluntary extension and flexion. Any motion present will be due to a laxity of the Ligamentum Patella. When ankylosis is fibrous it permits rocking, and when bony the Patella is absolutely fixed. When the Patella is adherent there is often, but not always, more or less adherence between the Tibia and Femur. If the knee joint is stiff in extension, adhesion of the Patella is of no importance. If the knee is flexed it may be straightened after the Patella is loosened.

CHAPTER XXX

RHEUMATISM—GOUT—OTHER JOINT AFFECTIONS

RHEUMATISM

Rheumatism is an affection which is said to be the cause of many joint diseases, with which it really has nothing to do. It is a constitutional disease affecting the joints, muscles and connective tissue. In the articular rheumatism the painful symptoms seem to pass from one joint to another. Often the manifestations of arthritis deformans are confused with the true rheumatic affections, and as in simple acute synovitis of the knee, in which no cause is known; it is diagnosed by many practitioners as a rheumatic joint affection. Also obscure cases of joint diseases are likely to be placed in this class. The structure attacked in true rheumatic joint affection is chiefly in the Synovial membrane, which secretes much fluid and takes on a proliferative action, with enlargement of the Synovial tufts. This condition may give rise to swelling of a joint without necessarily the presence of much effusion, and the capsule becomes thickened, although in prolonged cases the cartilage is likely to remain intact, but may become fibrillated at the edges and eroded in spots, while vascular pannus spreads in from the edges. The whole tendency is away from separation and toward connective tissue formation. The knee is most often attacked by rheumatic joint affections, then the foot, elbow, hand, shoulder, head, etc. They are monarticular or polyarticular. Rheumatic affections more frequently attack youths and people of middle age. The etiology of chronic rheumatic joint disease is obscure and little understood, and may be primary or secondary to acute attacks, or also it may follow a depression in the general condition, or occur as the result of exposure, or from some injury. In the treatment of foot disorders, it is not at all uncommon to mistake the pains and symptoms of flat-foot conditions for rheumatism. Where complaints of rheumatism in the feet and lower limbs are made, it is well to make careful inquiries as to the history of the case, and take every precaution to examine the feet for flat-foot conditions. It must also be remembered that flat-foot may co-exist with rheumatism, and not infrequently has flat-foot been shown to have been caused by rheumatism.

GOUT

Gout is a painful constitutional disease, acute or chronic, with joint inflammation and chalk deposits and an increase of uric acid in the blood. It is a joint affection with constitutional manifestations. It usually begins as an acute attack followed by inflammation. The common seat of affection is the Metatarso-Phalangeal joint of the great toe. It looks very much like a bunion on account of the swelling as it usually manifests itself in the great toe joint, although the heel and ball are sometimes affected. It gives rise to inflammation, swelling and redness, accompanied by severe pain. It is usually necessary to remove the shoe, and a thick woolen stocking worn for protection. In articular gout, the position of the bones is not changed, unless a sufficient quantity of urates is deposited to cause local absorption from pressure. Gout requires systemic treatment similar to rheumatism; local applications are also beneficial.

Another of the many painful ailments of the feet is rheumatic gout, which is very serious. This is also due to uric acid deposits in the blood.

It is found among persons who are of sedentary habits and who eat an excess of animal foods and partake of rich wines.

Treatment.—Inasmuch as gout is a constitutional disease it must be treated by the physician as such. It would appear from examination of a gouty foot that it is of local origin which then might be treated as such. The aid in giving relief consists of wearing wide soft kid shoes with a firm protective sole. Woolen socks should be worn, and if pain is severe, hot applications may be used as a temporary relief.

JOINT AFFECTIONS SIMULATING RHEUMATISM

A careful study of anatomy reveals the fact that the joints or articulations are a very important part of the body and must be carefully kept in mind in all orthopedic treatments. Inflammatory affections of the joints are of the most diverse character and may be due to injury, infection, rheumatism or gout and other constitutional conditions.

Under this heading are included numerous joint inflammations of septic origin, such as occur in septicemia, scarlet fever and diphtheria.

Arthritis deformans, chronic rheumatic arthritis, osteo arthritis, rheumatic gout, all can be classed as one subject.

Definition.—A deforming disease of the joints regarded by authorities as distinct from gout and rheumatism. They are characterized by destructive changes in the synovial membranes, cartilages and bone, and by bony outgrowths restricting the motion of the bone.

Incipient cases of arthritis sometimes closely resemble the mild forms of acute rheumatism, although its independence of rheumatism and gout and their causes is generally conceded.

Heredity plays a likely, if not an important, part. Shock, worry and grief have a closer relation. Females are more susceptible to the disease than males, especially sterile women, and those who have had uterine or ovarian disease. It usually begins between the ages of twenty and thirty. It may also occur in children under twelve and as late as fifty.

A slight injury or sprain or strain occurring in a weakly child or one convalescent from a disease such as measles or scarlet fever may result in arthritis.

The three structures which enter into the formation of the joint are all affected, but the changes probably begin in the cartilages.

These changes which take place consist of a proliferation of the cartilage cells, succeeded by fibrillation of the entire cellular substance, which subsequently undergoes mucous degeneration and absorption. The bone ends are laid bare, which subsequently become atrophied, smooth and eburnated. The bone ends and cavities are alike distorted; concavities may become convexities.

The edges of the cartilages, where overlapped by the Synovial membranes, thicken and form outgrowths which subsequently ossify and become the osteophytes which contribute to the deformity of the bone. The effect of the latter impairs motion without producing actual ankylosis only in rare instances, which may also include the vertebræ.

The Synovial membranes also become thickened and the tissue hypertrophied. Sometimes effusion in the joints and bursae is present. Fragments of cartilage may be attached to the tufts or, when they become detached, may lie loose in the joint.

A conspicuous part of the morbid changes is muscular atrophy.

Symptoms.—The difference in symptoms depends mainly upon the grouping of these lesions, which are subdivided into clinical varieties as follows:

1. Multiple arthritis deformans, including Heberden's nodosities and the progressive form, in which large joints are successively invaded in an acute or a chronic manner.

2. The monarthritic or partial form, in which one or two joints are alone attacked.

3. The acute polyarticular variety which attacks young people, females rather than males, and frequently following some infectious trouble such as scarletina, tonsilitis, influenza, etc. In these cases the joints become stiff and smaller, and the affection usually starts in the fingers and toes, but spreads to other joints as well. Sometimes these conditions manifest themselves with gout and rheumatism.

GONORRHEAL INFECTION OF THE FOOT

After the knee, the foot is the most frequently involved in this form of arthritis. It is the common opinion that men are more often attacked than women. It usually appears after the first week of infection, but it may take place at any stage of the disease. The milder cases may endure only a few weeks, and may be caused by the irritation of bacterial products.

The disease presents itself in various ways. It may include several joints, coming on with symptoms resembling those attending an attack of acute articular rheumatism; on the other hand it may attack only one foot and cause but slight constitutional disturbance. The Synovial membranes may be attacked causing an exudation of fibrin which, if not allayed, may form bands of adhesions interfering with joint movement, eventually eroding the cartilage and resulting in complete ankylosis. The periarticular structures may also be involved, producing a pronounced swollen area, with marked tenosynovitis, heat and redness. Inflammation is frequently absent although the swelling is pronounced, and abscess formations only appear when a mixed infection is present. Not infrequently are the Plantar Fascia and the Bursae, between the Tendo-Achillis and the Os Calcis, also involved beneath the posterior tubercle of the Os Calcis. As in articular rheumatism, the pain may be very severe, but rest and immobilization are more effective.

In flat-foot cases where the usual method of treatment is ineffective, it is well to inquire into the history of the patient to learn of a possibility of gonorrheal infection or gonorrheal arthritis, which require internal treatment.

CHAPTER XXXI

DISEASES AFFECTING THE FEET

Infantile Paralysis.—After an attack of anterior poliomyelitis the remaining paralysis more frequently affects those muscles which control the foot than any other group, the Tibialis Anticus being the one more often left in a paralyzed condition. The exact limit of time after an attack of this disease, when improvement may be expected from resuscitation of the cells in the Anterior Cornua, is very uncertain. It may be six months and probably longer. After the nerve cells have entirely recovered, due to stretching, atrophy and degeneration of the muscles, paralysis may still remain. Very little is known of the true causes of infantile paralysis. The disease is usually limited to the time of the first dentition in children. It may be due to exposure, to severe heat and sunstroke or of traumatic origin, and also has been known to occur during or soon after measles, scarlet fever, typhoid fever, pneumonia and erysipelas. The disease may attack healthy and unhealthy children, boys and girls alike, without any apparent cause. Paralysis is more common in children, and usually develops during the night rather than the day, and commonly during the hot months. Some regard the affection as infectious in origin, although this has not been definitely demonstrated.

Diagnosis is not difficult in typical cases, but in others the recognition of the disease is exceedingly difficult, and in the initial stage it is never easy to establish a positive diagnosis. The occurrence of localized pain at this time may present a misleading symptom, and sensitiveness of the affected limbs may lead one to believe that it is rheumatism. Due to a weakened condition of the tendons no visual movement is demonstrated, but if a finger is placed on it contraction may be felt.

Treatment consists in fitting accurate appliances to support and protect the paralyzed limb. In those cases in which there is only a slight eversion of the foot, with a small degree of valgus, an arch support such as is used in flat-foot will answer the purpose in correcting the deformity.

MYASTHENIA (Intermittent Limping)

Is a condition which is severe. Spontaneous cramp-like pain occurs in the calf of the leg while walking. If the limbs are rested for a moment the pain is relieved, the attack returning when walking is resumed. Due to circulatory disturbance there is a feeling of coldness in the foot, accompanied by a blanching of the skin. In two cases reported by Lovett there was an absence of pulse in the Dorsalis Pedis and in the Posterior Tibial arteries. If syphilis, diabetes or chronic alcoholism exists specific systemic treatment may relieve the local condition.

SYPHILIS

Although this disease is widely prevalent, it is remarkable that in our large orthopedic clinics the number of syphilitic bone and joint diseases treated are limited. Usually the syphilitic baby is a puny, wrinkled specimen, bearing certain indications of the disease. Babies affected thus present little difficulty in diagnosis, but it should be remembered that some who later develop characteristic lesions are perfectly normal in appearance when born. In infants hereditary bone syphilis often takes the form of an osteochondritis of an epiphysis, accompanied by pain, swelling and at times effusion. The knee and elbow are more vulnerable and the affection is frequently polyarticular.

This process, if left unchecked, may result in local destruction or epiphyseal separation. Persistent unilateral or bilateral hydrops of the knee, which is a tardy manifestation of hereditary lues, is seen in older children, but may clear up on mixed treatment. This condition may also be due to chronic tubercular synovitis, but does not yield to specific treatment. Hereditary or acquired bone lesions may be due to an osteo periostitis, with pain, tenderness and overgrowth of bone in thickness and length, or to gummata, involving bones and joints. The elongated saberlike Tibia, the result of chronic specific osteo periostitis, is occasionally seen in children, with multiple bone swellings of unmistakable significance, usually near the joints.

RAYNAUD'S DISEASE

Is a nervous disease which affects vasmotion. It may affect any of the extremities or other parts of the body.

There are three stages, the first being marked by attacks of cold and emotional excitement (local syncope), and the second stage by capillary congestion and livid swelling (local asphyxia), also blueness of the skin (local cyanosis).

The third state, which is that of gangrene, may eventually result with mummification of the part.

In the first stage or that of syncope, due to failure of the heart's action, the parts, usually the Plantar surface of the toes, become white and cold, attended with pain, which at times is not severe while at others excruciating. It may be caused by exposure to a low temperature, not necessarily a very cold one, or by standing or walking.

Rest and warmth may restore the part to its normal condition, and the disease manifest only the symptoms of the first stage, probably not progressing to the second. The disease may be arrested at any time, not returning for months or years.

In the second stage, which usually follows the first, that of local asphyxia (suspended animation from suffocation or a deficiency of oxygen in the blood), the parts become blue or purple with livid swelling. As in the first stage the pain varies.

The third stage does not always follow. When this condition is recognized the patient should be referred to a physician.

RICKETS

Believing that the various bone deformities are the result of rickets, a definition of this condition is indispensable to clearly understand these various diseases as affecting the feet.

Rachitis, or rickets, is a constitutional disease which affects young children, marked by an increase of cell growth of the bones. Its chief characteristics are manifested in the Osseous system, a local or general disturbance of the normal process of ossification being the result. The Epiphysis (a process of bone attached to another by cartilage which later ossifies) becomes enlarged and the bone affected becomes soft and pliable. Their growth is delayed and deformities of a serious nature arise. The disease is one of malnutrition appearing in children within the first three years of life, though it may appear later. It is induced principally by giving the child insufficient food or the wrong balance of foods; also by the want of air, sunlight and cleanliness.

Treatment.—The most essential is to correct the hygiene and build up by good diet. When the feet and legs are affected splints and proper braces should be applied.

VARICOSE VEINS

Varicose veins and varicose ulcers of the leg are not strictly orthopedic, but as they are both common and troublesome it would be well to acquaint you with a simple mode of treatment which has often proved efficacious.

Varicose veins, or varix, is a condition where the vein has become permanently lengthened and dilated. The superficial veins of the legs, especially the internal and external Saphenous veins, are the most liable to become affected. Anything that will lead to continued distension of the vein, such as prolonged standing, weight lifting, severe exertion, etc., that throws a heavy strain on the walls and valve of the veins, will cause the condition. Other causes are tight clothing, such as garters, corsets and active causes as pregnancy, organic heart and lung diseases.

Treatment.—First remove as much exertion on the veins as possible. Fit the patient to foot-eazers, arched high to distribute the weight, and look into the matter of correct shoes. Then the veins may be supported by strapping, bandaging or elastic stockings, the latter affording the most relief to the patient. Varicose veins and ulcers can only be cured by extirpation. Under the conventional mode of treatment varicose ulcers are difficult to heal while the patient is active, but under zinc oxide adhesive plaster strapping they heal readily. The ulcer is covered and its edges drawn together by overlapping strips of one inch wide zinc oxide adhesive plaster nearly encircling the leg. This dressing is to be renewed every other day, no other treatment being required.

ANKYLOSIS

By ankylosis is meant a condition of immobility resulting from some inflammation or injury to the articular structure or joint.

Ankylosis is derived from a Greek word, meaning crooked or hooked, and is a term used to designate immobility, stiffness or consolidation of a joint, whether in a straight or crooked position. It may be either true, osseous, complete, false, fibrous or incomplete. When the state of a joint is fixed and absolutely motionless the ankylosis is said to be true or complete, and is known as false, fibrous or incomplete ankylosis when the motion of the joint is limited. Ankylosis more frequently affects the Ginglymoid (a joint resembling a hinge) articulations, but it may occur in any kind of joint. Usually only one joint is ankylosed in the same individual, but others may be affected at the same time.

Treatment.—Treatment depends greatly upon the condition found. In simple or incomplete ankylosis, where adhesions are not of much density, massage, manipulations and exercising the parts will restore mobility. In the more severe cases more vigorous methods and surgery must be resorted to to separate the joint.

CHAPTER XXXII

DISEASES OF THE FEET

VERRUCA OR WART

Verruca, or wart, is a clearly defined epidermal growth, ranging in size from a pinhead to the size of a pea or larger. It may be hard or soft.

There are many varieties of verruca and they are known by the form of their development.

Verruca Vulgaris is the wart which is usually seen upon the hands, individually or in numbers. It is a round, firm, clearly defined elevation with a broad base, and may have a smooth or roughened surface due to hypertrophy of the Papillae. Their color is usually of a dark brown and of slow growth.

Verruca Plana (verruca senilis; verruca seborrhœica; keratosis pigmentosa) is a flat wart which develops upon the face, trunk and extremities, chiefly of people advanced in age. It is dark of color, flat, usually covered by greasy scales and ranges in size from a pea to a finger nail. Under the epidermal covering a slightly bleeding and granulated surface is seen. These warts, particularly those highly pigmented, may give rise to skin cancer.

Verruca Filiformis, as its name implies, is a thread-like growth, is soft and covered with a smooth skin. This form of wart is most frequently seen on the neck and eyelids.

Verruca Acuminata (venereal wart; condyloma acuminatum) is usually found on or near the anus or genitals of both sexes, and in most cases of venereal origin. The lesions may be few or numerous, of various sizes and shapes, pointed and of a pinkish, reddish color. Where they appear on the cutaneous surfaces they are dry and firm, but on the mucous surfaces soft and moist, at times becoming purulent with an offensive penetrating odor. The actual causes of verruca are obscure, but the acuminate form is probably due to irritating discharges, particularly those of gonorrhea.

Warts generally occur in early adult life and may be contagious. Local treatment consists in removing the warts by excision, the use of caustics or electrolysis.

SUPERNUMERARY TOES (POLYDACTYLISM)

Is a deformity in which more than five fingers or toes are present, and is a source of mortification, sometimes producing mental agitation which is often the cause of alarming nervous symptoms. There are several classes but all of congenital origin. Records show that there have been cases where ten and as many as thirteen toes were found on one foot. Some were fully formed but more often were

Chart No. 164
Supernumerary Toes

imperfect and associated with some other deformity. This deformity should be corrected when the child is still young, as growth obliterates many of their effects. The removal of the supernumerary toes can be accomplished with perfect safety at two or three months after birth.

WEBBED FINGERS AND TOES

As a rule this condition is congenital, but it may arise from burns or inflammation. The fingers in this condition are firmly held together by strong tegumentary adhesions. Surgical operation is necessary to correct the deformity.

PERFORATING ULCER OF THE FOOT

Perforating ulcer of the foot usually occurs on the sole of the foot in the Metatarsal region, is painless and shows no tendency to heal. Other indications of the nervous condition underlying the ulcer may be found in the other parts of the body, such as the condition of the skin and nails of the hand, or may be associated with peripheral neuritis or with the central lesion. The ulcer, due to its absence of pain, is usually neglected, and is about an eighth to a quarter of an inch in diameter before treatment is applied, sometimes reaching to and involving the bone. It is frequently caused by trimming away an original growth of callous which has become infected by the use of a knife or scissors, which develops a small ulcer underneath the deeper layer of skin and finally breaks through; hence its name, perforating ulcer. The callous formation about the ulcer often leads one to believe that it is an infected corn.

Treatment.—The true cause should be learned and proper treatment applied. The wound should be thoroughly cleansed, then lightly packed and dressed. Pressure should be removed from the surrounding area, which can be accomplished by wearing an arch support or foot-eazer.

CHILBLAINS (PERNIO)

Chilblains (Pernio) are usually due to poor circulation, which causes congestion of the tissues of the skin, giving rise to swelling and redness. Chilblains are produced by long exposure to cold. The skin assumes a purplish color and accumulation of serum in the cellular tissues accompanied by burning pain and itching. Anemia is a predisposing factor in chilblains.

Treatment.—Comfortable shoes should be fitted, and wide stockings of cotton should be substituted for woolen ones, or vice versa. The chilblain lotion, applied locally, often proves very useful in affording relief to the itching, burning and swelling, but proper foot gear is important and beneficial. Standing or sitting with feet on hard, cold floors is very harmful. Apply ointments containing tannic acid or apply chilblain lotion to the parts, let dry and then bandage with soft gauze.

FROST BITE

Congelation and Frost Bite.—This condition is produced by long exposure to severe cold. As a rule the frost bite occurs very slowly and the first symptom is felt by the numbness and lack of feeling in the parts. In the usual frost bite the action of the cold has been sufficient to shut off the circulation until some of the tissues have died. The feet should then be thawed out slowly by rubbing with snow. Diagnosis is not difficult.

Treatment consists in restoring gradual circulation by massage with cold applications. Care should be taken not to induce a sudden rising of temperature, as it may result in a paralysis of the muscular coats. The foot should be kept moist one or two days, then dried and powdered with boric acid and wrapped in wool and placed in an elevated position. If gangrene sets in a physician should be called.

HYPERIDROSIS OR EXCESSIVE PERSPIRATION

Hyperidrosis, Excessive Sweating, is a condition which attacks the feet and causes an excessive exudation of sweat and has a pungent and penetrating odor, which is very disagreeable and sometimes annoying.

This disease is very common, especially in summer, among a large percentage, while in others it is found most prevalent in cold weather. The feet are always moist, which makes the hosiery damp and wet, affecting the wear of the shoes. It is not at all infrequent to find shoes that have rotted through due to this excessive sweating. There are various causes, but anything that depresses the nervous tone will sometimes give rise to the cause.

Treatment.—Internal treatment is sometimes indicated, but the most effective is to bathe the feet, using pedico granulated foot soap firmly rubbed and massaged over the feet to keep them thoroughly clean and stimulate healthy skin action. Then powder with antiseptic foot powder, using all other hygienic precautions, such as change of hosiery and shoes.

ANHIDROSIS OR SCANTY PERSPIRATION

Anhidrosis.—Scanty perspiration with a dry and burning skin is more the result of constitutional disturbances than from a local disorder. Those persons affected with rheumatism or dyspepsia are particularly liable to it and suffer more or less, as the stomach is deranged. The harsh, hot skin can be relieved by bathing the feet in warm water, mixed with bran, and by using pedico foot balm, massaging the feet thoroughly at night, and also by resting them frequently, especially after walking, but more good can be derived from the restoration of health. Thus the patient should be referred to a physician.

BROMIDROSIS OR FETID PERSPIRATION

Bromidrosis.—The functional disease of the sweat glands of the feet, which is present, is thought to be of nervous origin but the fetid perspiration is due to bacterial growths. The feet have a very offensive odor and the disease is quite common among both men and women. The actual secretion may be normal, yet of an unhealthy quality.

Treatment.—Absolute cleanliness is the first essential. This is accomplished by using pedico granulated foot soap, rubbing and massaging to thoroughly cleanse the skin, then bathing the feet in an antiseptic lotion of footdok tablets, after which they should be dried and antiseptic foot powder applied. Shoes and stockings should be changed frequently.

Bathing the feet alternately in hot and cold water or in a solution of tannic acid and borax will often prove beneficial; change of stockings is also recommended.

ECZEMA

Eczema.—Eczema is an inflammatory skin disease with vesiculation, infiltration, watery discharge and the development of scales and crusts. It may be an acute, sub-acute or chronic multiform disease. The lesions vary considerably in character and the disease is usually attended with fever, restlessness, itching and burning as well as other symptoms of constitutional disturbances.

Eczema is a catarrhal inflammation of the skin, and the itching probably is due to the involvement of cutaneous nerves. It is not contagious or hereditary, although in some cases there is an hereditary predisposition handed down from parent to child, also some persons are more susceptible to the disease than others. There are many different forms of eczema and sometimes they are difficult to diagnose correctly.

Causes.—The constitutional or predisposing causes are rheumatic diathesis, defective kidney elimination, albuminuria, anemia, etc. The most common causes are dyspepsia, constipation, mental and physical exhaustion; neurosis of functional or organic origin are also likely to cause the disease. The local or exciting causes are most numerous. Any external agency that may produce a dermatitis may result in eczema. Heat, cold, alkalies, acids, excessive local use of water and other chemical substances are among the most common of the local causes.

Treatment.—The parts should be kept free from water and soap and all irritating properties, and a mild, healing ointment containing salicylic acid should be applied. A specialist should be consulted.

SYPHILIS

Syphilis, the Squamous or Papulosquamous Syphilide, is a popular eruption in which scaling is a prominent feature. The scales are of a dirty gray color, usually adherent and situated on the apex of the papules or encircling them at the base. This eruption is most frequently found on the palms and soles, and because of the thickness of the skin and firm attachment of the epidermis of these regions the papular feature may be entirely absent, the lesions representing sharp, clear defined, dull red spots covered or surrounded by epidermal shreds. Eruptions on these parts are very persistent and rebellious to treatment. Squamous syphilo-derm eruptions on the Palmar and Plantar surfaces may resemble psoriasis and squamous eczema of these parts, but psoriasis is a more diffused disease with a tendency to affect the Extensor surfaces, usually the elbows and knees, and never affects the palms and soles exclusively. Squamous eczema very seldom is confined to the palms and soles, but usually also involves the backs of the hands and feet, presents a more inflammatory aspect and is more general in distribution, and intense itching is another characteristic. In syphilis the lesions are deeper seated, darker in color, usually of a ham or copper hue, and usually itching is absent.

PLANTAR NEURALGIA

Erythromelalgia, Plantar Neuralgia, is a chronic disease in which there is a painful congestion of the feet. Usually the pain first limits itself to the heel or to the fore foot and occurs only at night but eventually extending over the entire Plantar surface, being present both night and day. In this stage walking or standing is very painful.

Dana construes this a form of Plantar neuralgia, and that in rare cases the pain of sciatica is limited to the Plantar nerves and is accompanied by an anesthesia and paresthesia of this region.

OSTEOMA

Osteoma.—Any bone may be the seat of an osteoma. These are found in the lower extremities, the Femur or Tibia or on the Dorsal surface of the Phalanx of the great toe. It lifts the nail upward by the tumorous growth. Surgical operation is a very simple way to correct this condition.

BLISTER

Blister.—Blisters may develop on the feet due to ill-fitting shoes or from a rough seam with unaccustomed exercising. They may contain clear or bloody serum. Absolute cleanliness is essential to prevent infection.

Treatment.—Apply a moist dressing of boracic acid or a healing cold cream until the soreness disappears. Then apply alcohol to harden the skin tissue and a zin-ox pad to prevent recurrence.

CHAPTER XXXIII

FRACTURES AFFECTING THE FEET

A fracture, in the surgical sense of the term, is meant the breaking of a bone or cartilage. The liability to fracture of the different bones of the body varies greatly, depending on their difference in size, shape and degree of exposure to external violence or extreme muscular action. Fractures are more numerous in men than in women in the proportion of approximately three to one, it varying greatly at different ages. In infancy the difference is insignificant, but in middle life fractures are ten times as frequent in men as in women; between the ages of fifty and seventy years the differences again become slight. After seventy years of age fractures are more common in women than in men. Due to the disproportionate increase in the number of fractures of the neck of the Femur, we have a reversal of conditions.

There are numerous varieties of fractures which are constituted by differences in the extent of the injury to the bone or to the surrounding soft parts in the seat, shape and direction of the fracture, in the relation of the fragments to each other, and in the number of bones involved. These varieties may be grouped into five divisions, and many subdivisions, marked by important clinical differences, as follows:

1. Incomplete fractures.
    - (a) Fissures.
    - (b) True incomplete, "green stick"; bent bone.
    - (c) Depressions.
    - (d) Separation of a splinter or of an epiphysis (long protuberance or outgrowth).
2. Complete fractures, subdivided according to
    - (a) Direction and character of the line of fracture into transverse, oblique, longitudinal, spiral, toothed or dentate, V, Y or T-shaped, and comminuted (broken up).

(b) Seat of the fracture, into fracture of the shaft, of the neck, of the upper, middle or lower third intercondyloid, separation of epiphysis; and

(c) If extending into a joint intra-articular.

3. Multiple fractures, comprising fractures of two or more non-adjacent bones and two or more fractures of the same bone.
4. Compound fractures.
5. Gunshot fractures.

The term simple fracture is used in contra-distinction to the term compound fracture, and is a fracture without any rupture of the overlying skin. Spontaneous fracture is one due to slight force, as when there is disease.

Ununited fracture, one in which a union of the bones has failed.

Incomplete Fractures are fractures in which the continuity of the bone has not been completely lost, or a fragment has not been completely detached.

Fissures are characterized by the existence of a split or crack in the bone, and which does not entirely circumscribe a fragment separating it from the rest of the bone. In the bones of the cranium it is of common occurrence, and in the long bones very rare, except when associated with other varieties. In the short or spongy bones it is almost unknown. Fissures connected with complete fracture are common, and sometimes very long, extending into a neighboring joint. These long fissures are called a longitudinal fracture. Forcible bending of a long bone will probably produce a long isolated fissure. The importance of a fissure is slight, except when it extends into a joint. In some cases the injury has been followed by suppuration beneath the periosteum, or within the bone.

Incomplete Fracture, "Green-Stick Fracture," Bent Bone.—This variety is characterized by a fracture involving only a portion of the thickness of the long bone at the seat of the fracture.

Depressions are fractures in which a portion of the outer layer of a flat bone, or the spongy portion of a long bone, has been driven inward by direct violence, usually a blow with a pointed instrument. This injury is most frequently seen in the vault of the skull, being termed a fracture of the outer table. Occasionally it is seen in the limbs in connection with a complete fracture.

Separation of a Splinter of an Epiphysis.—Two classes of fractures are included in this variety which differ widely in their mode of production, but have this in common: that the fragment does not comprise the entire breadth or thickness of the bone, and that consequently the continuity of the latter is not destroyed.

In the first class, a splinter or fragment of the bone is broken off by direct violence, and in the second class a long prominence is torn off by the violent contraction of the muscle attached to it, or by traction through a ligament.

Complete Fractures.—By a complete fracture, when applied to a long bone, is meant the division into two or more fragments by a line of fracture crossing its long axis.

Subdivision According to the Direction of the Line of Fracture.—Terms in use are transverse, oblique, splintered, spiral, V-shaped, T or Y-shaped, toothed, or dentate, and longitudinal. As a result of direct or indirect violence which bends a long bone, the fracture is either practically transverse or markedly oblique, with or without splintering.

Spiral fractures are very rare, and are produced by torsion of the bone. They are found in the Femur, Humerus and Tibia. In the latter they are known as V-shaped, and can be readily recognized by the sharp point of the upper fragment, which can be felt midway between the crest and the internal border of the bone. From the reentrant angle corresponding to this point a fissure runs down to the ankle joint.

Longitudinal fractures include fractures which are very oblique and run from one side of the bone to the other, or from one end of the bone to, or nearly to, the other, and fractures which split lengthwise with a long fragment intermediate between two transverse fractures. The latter is produced by great crushing violence. In the other forms the violence is indirect. A bend or twist of the bone, or a blow received at one end, is apparently the cause. The serious results which usually follow are due, in some, to the implication of one or both joints.

A comminuted fracture is a fracture of the shaft of a long bone, and in addition to the complete division of the bone into fragments, there is also splintering of the portion of bone adjoining the fracture, or of one of the fragments.

Varieties Dependent Upon the Seat of the Fracture.—A fracture may occupy any portion of the bone and consequently is known by its name. For example, fracture of the neck of the Femur, of the lower third of the Tibia, of the head, of the shaft, of the Inner Condyle, of the Acromion; Intercondyloid fracture, when it passes across the shaft and also downward between the Condyles; separation of the Epiphysis.

Separation of the Epiphysis.—This term applies to separation of the Epiphyses which have not yet become united by bone with the shaft. Union of the different bones takes place at different ages, but is ultimately complete in all; in the female at twenty-two years of age and in the male at twenty-five.

Intra-Articular or Articular Fractures are fractures in which the main line of fracture, or a subsidiary one, extends into a joint. Examples of fractures which are common are those of either Condyle of the Femur or Humerus, intercondyloid fractures of the same bones, fractures of the Patella and Olecranon. The importance of this variety arises partly from the implication of the joint in the inflammatory reaction following the trauma, but chiefly from the change in the mechanical condition produced by the displacement of the fragment and the formation of adhesions or of callous. Thus, the result after a fracture of the Patella, in which permanent displacement is slight, is usually very good, while that following a fracture of a Condyle of the Humerus or of the head of the Tibia may result in great limitation of the motions of the joint. In the young, excessive formation of bone outside of, but near to, the joint as the result of the traumatic irritation of the Periosteum may also mechanically limit the motions of the joint. An important cause producing bad results is due to the difficulty or impossibility of properly reducing the displacement, or maintaining the reduction, because of the small size of the fragment and the lack of efficient means of acting upon it. Hemorrhage into the joint, inflammation of the Synovial membrane, and adhesions of its opposing surfaces, inflammatory thickening, retraction and loss of pliability of the periarticular tissues are other causes. The inflammatory reaction varies in the degree of these changes.

Multiple Fractures are fractures occurring simultaneously to two or more nonadjacent bones, and two or more fractures of the same bones whose lines are not continuous with one another. Multiple fractures of different bones are usually caused by great violence acting in part directly against the shaft, such as the fall of a heavy weight, or by the striking of the thigh with some object when thrown from a vehicle or the like.

Compound Fractures are fractures with a communicating wound of the skin. The importance of this communication arises through the possibility of infection of the wound from without, with all the risks involved in the consequent suppuration of the bone and the lacerated soft parts. Compound fractures in a large proportion are caused by direct violence, and the consequent laceration of the overlying soft parts, which is to be considered a serious addition to the fracture.

As the student of the foot is mostly concerned in affections of the lower limbs, I will describe the fractures with which he will come in contact. Fractures are only treated by the surgeon.

Fracture of the Patella is more frequent in men than in women, and in middle life than in childhood or old age. The cause may be direct or indirect—a blow or fall upon the patella, the sudden vigorous contraction of the Quadriceps Extensor, or the sudden flexion of the knee against the opposition of the quadriceps, or by direct violence.

The fracture is usually transverse or slightly oblique, at or just below the middle of the bone; sometimes it lies very near one end of the bone, especially the lower. Vertical, comminuted and oblique fractures are due to direct violence, and do not usually show much displacement.

Fracture of the Upper End of the Tibia and Fibula.—Fractures of the shaft of the Tibia and Fibula constitute about one-fourth of those of the lower extremity, and about six per cent of all fractures. The usual seat of fracture is at or near the junction of the lower and middle thirds. The Fibula is usually broken at a higher level than the Tibia when both bones are broken.

Fractures of this variety are very uncommon in childhood, their maximum of frequency being found between the ages of thirty and sixty years. These fractures are caused by direct or indirect violence, in the former such as a blow received directly on the part, the fall of a heavy body, or the kick of an animal; in the latter a fall from a high point, a twist of the limb, especially abduction.

The line of fracture may be transverse, oblique or longitudinal. In the latter case it passes into the joint and separates only a portion of the articular end from the shaft. The internal tuberosity of the Tibia may be crushed, with rupture of the external lateral ligament. Transverse fractures caused by direct violence, such as the fall of a heavy body, the kick of a horse, have been observed very near the articular edge. Comminuted fractures have also been caused by direct violence and by falls upon the feet, the shaft penetrating and splitting the head.

Oblique fractures, the line running into the joint and separating the whole or part of either tuberosity, appears to be caused by abduction or adduction of the leg, the fracture taking place on the side the leg is bent.

Due to the proximity of the joint, and the possibility of inflammatory complications, with more or less complete loss of the functions of the knee which that and the derangement of the articular surface in oblique and comminuted fractures involve, make the prognoses very serious, and also the long period necessary for consolidation.

Fractures of the Lower End of the Leg.—In this group are included the fractures of both bones of the leg, in which the lower end of the Tibia is crushed or splintered, separation of the epiphysis of the Tibia, and the allied supermalleolar fracture. Fractures of both bones at or near the joint caused by forcible eversion of the foot at times aided by the weight of the body, the most common being known as Pott's fractures, are very numerous and varied. The action of the causative violence through the foot is a feature which they all have in common.

Fractures by Eversion and Abduction of the Foot (Pott's Fracture).—Pott's fracture is a very common injury and of especial importance because of the great disability which results. The lesions vary much in extent and detail. Occasionally fracture is entirely absent, and some forms have been classed with dislocations. The cause is a twist of the foot, eversion and abduction, and by the weight of the body. The lesions take one or the other of two distinguishable forms, according to the eversion or the abduction which pre-

Chart No. 165
Pott's Fracture.

dominates. If eversion is the only or main movement, the force is exerted through the internal lateral ligament, breaking the Internal Malleolus squarely off at its base and pressing the External Malleolus outward, rupturing the Tibio-Fibular ligament, and breaking the Fibula close above the Malleolus. At times instead of pure rupture of the Tibio-Fibular ligament there is a wrenching of the portion of the Tibia to which it is attached in front, behind, or both.

On the other hand, if abduction of the front part of the foot is the sole or chief movement, the first and last of these three lesions vary. Instead of a square break at the base of the Internal Malleolus there is an oblique, almost marginal fracture of its anterior portion or, more frequently, a rupture of the anterior portion of the internal lateral ligament. With continued movement the torsion of the Fibula produces an oblique fracture, the upper end being found three or four inches above the tip of the Malleolus.

Symptoms.—Diagnosis is readily made at a glance, the appearance of the region being so characteristic. The characteristic features are outward displacement of the foot, with a corresponding prominence of the Internal Malleolus or the adjoining portion of the Tibia. In

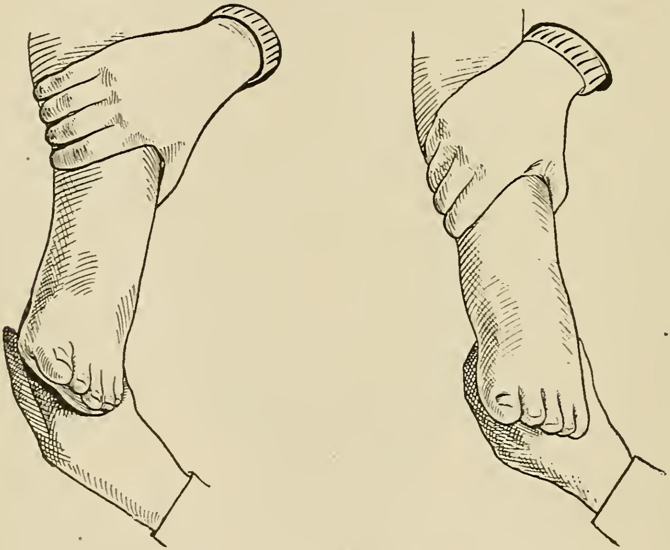


Chart No. 166
Showing Manner in Which Test is Made for Mobility of Pott's Fracture.

marked cases backward displacement can also plainly be seen. Other signs characteristic of this condition are abnormal lateral mobility at the ankle. On pressure these points of tenderness can be felt by the patient, one in front of the position of the Tibio-Fibular ligament, in the groove between the Tibia and External Malleolus, showing rupture of the ligament; one at the base of the Internal Malleolus, marking the fracture of the Malleolus or the rupture of the anterior portion of the lateral ligament, and the third over the outer aspect of the Fibula, marking the fracture of the Fibula and marked ecchymosis beneath the External and Internal Malleolus. Sometimes there is an abnormal mobility of the two fragments which may be recognized. Pott's fracture is very frequently recognized by the student of the foot owing to its close resemblance to flat-foot. In many instances shoes must be especially built having extremely wide shanks and low broad heels with extension under inner border. Mechanical aid is of great importance, which consists of special plates or arch supports to restore balance to weight carrying point.

Fracture of the Fibula.—Fracture of the Fibula is by direct violence, muscular action (contraction of the biceps) or more frequently by forcible adduction of the leg acting through the external lateral ligament attached to the head of the Fibula. Paralysis of the Extensor and Peroneal muscles, with loss of sensation in that region supplied by the musculo-cutaneous branch of the Peroneal nerve is usually the result after accident.

Fracture of the Astragalus.—Fractures of the Astragalus are commonly the result of falls from some high point, the bone being broken between the Calcaneum and the Tibia. The lesion is frequently associated with fracture of the Calcaneum and with dislocation at the ankle and fracture of the Fibula; in other cases the force may act transversely. The direction and extent of the line of fracture vary considerably; the division of the bone may be transverse, longitudinal, horizontal, oblique, or into numerous pieces, and the fragments widely separated and dislocated. When there is no displacement or external wound, diagnosis is difficult. Although there is an indication of severe injury to the foot—pain, swelling and inability to bear the weight of the body on it—the symptoms are not distinctive.

Fracture of the Calcaneum.—A fall upon the foot from a height; by contraction of the muscles attached to the Tendo-Achillis, and by forcible inversion of the sole of the foot, are causes which may break this bone. The causes vary the extent and position of the fracture. Thus in a fall directly upon the sole, the bone is splintered or crushed. At times the bone is also split longitudinally. Forcible pressure on the ball of the foot may cause the same result.

Fracture of the Sustentaculum Tali.—The causes of this fracture are forcible inversion of the sole of the foot. Immediately there is a change in the position of the foot from inversion to eversion and a consequent permanent sinking of the inner border of the foot and Internal Malleolus (valgus). There is a shortening of the heel by slight displacement of the Calcaneum forward. Pain and disability.

Fractures of the Metatarsal Bones are frequently the result of direct violence, consequently often associated with contusion or laceration of the skin, although the fracture may not be compound. The first Metatarsal bone is the one most frequently broken, the fifth the next in order of frequency. There is little tendency to displacement except when several bones are broken simultaneously. The displacement is usually of the broken end of either fragment toward the Dorsum of the foot.

Localized, abnormal mobility, and grating of the bones when the first or fifth is broken, and pain when the corresponding toe is pressed bodily backward against the Metatarsus.

A simple fracture is not a serious injury, the results usually being most favorable, but a compound fracture may give rise to suppuration, necrosis of the fragments, and grave inflammatory complications.

Fractures of the Phalanges are caused by direct violence and are usually compound. They are similar to injuries of the hand, and may give rise to serious inflammatory complications.

Signs of Fracture.—The history usually given by the patient is that, as the result of some accident, he felt or heard something give way with a snap and experienced sharp pain which became intensified on attempting to move the part. On examining it should be contrasted with the other limb or member and noted if there is pain, bruising and swelling, also if the skin is lacerated and torn. Note if there is a change in the shape of the limb. In old complete fractures X-rays should be used to make a positive diagnosis.

Treatment

First Aid.—It is well to know the first aid treatment until a surgeon can be called. In moving the patient from the place of the accident, first secure the limb or member in as good a position as is possible; improvised splints frequently must be resorted to, such as sticks, umbrellas, newspapers, etc. If a broken leg, it may be firmly tied to the other limb which can be used as a temporary splint. It is then necessary to set the broken parts, thereby reducing the deformity. The massage and manipulation necessary to bring about full and complete use of the parts then follow. This work is to be done under the care of an experienced surgeon.

CHAPTER XXXIV

DISLOCATIONS AFFECTING THE FEET

A displacement from each other of the articular portions of the bones entering into the formation of a joint may be either permanent, total or partial.

When there is a direct separation, either temporary or permanent, of articular surfaces, without lateral gliding of one upon the other, it is known as a Diastasis.

When the displacement is only momentary, the parts immediately returning to their normal relations, the injury is classed as a Sprain. When the coverings of the joint are ruptured, and the joint cavity communicates with the air, the dislocation is known as Compound, and when the neighboring tissues or surrounding parts are lacerated it is said to be Complicated. Under circumstances without lacerations it is known as Simple. When the articulating surfaces remain in partial contact, the dislocation is termed Incomplete, and when the bones are entirely separated, it is known as Complete.

In injuries where two or more bones are simultaneously dislocated, as two fingers, a hip and shoulder, it is said to be Multiple. The primitive or primary displacement is the one immediately affected by the causative violence which produces the dislocation. If the dislocated bone afterward shifts to another position, the displacement is said to be Consecutive or Secondary.

Usually a dislocation is produced suddenly by great violence, or by muscular action, or by the combination of the two acting together on a healthy joint. Produced in this way, it is called Traumatic.

There are cases in which the joint is altered by disease previous to the occurrence of the dislocation, this latter also being affected by the gradual action of the muscles or by gravity. These dislocations are known as Spontaneous, and present many varieties. Congenital dislocations are composed of those in which the dislocation occurs during intra-uterine life, probably the result of malformation or defective development. Those dislocations produced during delivery are Traumatic.

Dislocations of the Fibula—Of the Upper End—Of the Lower End.—The Fibula may be dislocated at its upper or at its lower end, and is caused by external violence, or by muscular action, or by unequal growth of the Tibia and Fibula.

Dislocations of the Upper End.—The displacement is usually outward and forward, in others backward and in a few upward. As the head of the Fibula is situated behind the most external part of the Tibia, a forward dislocation must also be outward. Numerous cases, complicated by a fracture of either the Tibia or Fibula or of both bones, have been reported.

Dislocation Forward.—A fall with the leg bent under the body or a muscular effort without a fall are causes that will produce a forward dislocation of the Fibula; also there is a belief that the forcible depression and inversion of the foot may be a factor in the production. The head of the Fibula can be seen and felt in front and outside of its normal position, and the tendon of the biceps shows plainly in any unusual curve. Because of pain the patient usually is unable to walk, but free movement of the knee is possible.

Backward.—Forcible contraction of the biceps, a twisting of the leg with rupture of the Tibio-Fibular attachments by the pull of the External Lateral ligament of the knee, the biceps acting to displace the bone backward, are causes which produce a backward dislocation.

Upward.—There are only three cases of this form reported, those of Boyer, Stall and Sorbets. In Boyer's case the patient appears to have received a dislocation outward of the foot, or a Pott's fracture of the ankle. The Fibula, instead of breaking, had been pushed bodily upward; the upper dislocation was corrected after the foot was restored to its place, with recovery of the patient.

Dislocations at or Near the Ankle—Dislocations of the Foot (Tibio-Tarsal)—Sub-Astragaloid—Total Dislocation of the Astragalus—Medio-Tarsal—Congenital.

ANATOMY

The principal movements of the foot are those of flexion and extension or Dorsal and Plantar flexion, which take place in the joint formed by the Astragalus, Tibia and Fibula, and that of adduction and abduction and respectively combined with inversion; eversion of the sole, which takes place in the joints between the Astragalus on one side and the Calcaneum and Scaphoid on the other, being aided by slight motion between the Os Calcis and Cuboid. The axis of the first joint, which is the ankle, is horizontal and almost transverse, the inner end inclining forward, the other end running obliquely from a point near the inner tuberosity of the Calcaneum upward and forward to a point on the upper surface of the neck of the Astragalus. The Astragalus articulates above with the under surface of the Tibia, on the sides with the Malleoli, between which it is placed so securely that lateral motion is impossible. From the Malleoli the lateral ligaments pass on each side to the Astragalus and Calcaneum, the lower ends of the Tibia being bound together by ligaments in front and behind. The range of Dorsal and Plantar flexion is about ninety degrees. Thus the articular surface of the Astragalus, being somewhat narrower behind than in front, lateral motion of the joint is possible when in full Plantar flexion.

The head of the Astragalus, which is round, articulates with the posterior concave surface of the Scaphoid, the Inferior Calcaneo-Scaphoid ligament and slightly with the anterior end of the Calcaneum. Between them is the strong Interosseous ligament, which fills the canal formed by a groove on each bone separating its two articular surfaces, binding the bones firmly together. The maximum range motion of these joints is about forty degrees, and is limited partly by the ligament and bony contact.

Dislocations of the Foot—Tibio-Tarsal Dislocations.—Displacements of the Astragalus and foot are so complex that the nomenclature of the various dislocations occasions serious difficulty and much confusion. To facilitate the study of dislocation I shall use in the classifications four terms, namely: Dislocations Forward, Backward, Outward and Inward. Of the four the first two are pure dislocations, the latter being frequently placed cases in which the displacement is associated with fracture of one or both bones of the leg.

Dislocations Backward—Dislocation of the Lower End of the Tibia Forward.—In these dislocations the Astragalus, and with it the foot, is displaced backward. The distance of the displacement is variable, and there is also a rupture of the lateral ligaments and at times of other parts of the capsule, with fracture of one or both Malleoli or of the posterior edge of the lower articular surface of the Tibia.

Extreme Plantar flexion of the foot is usually the cause, in which the posterior border of the end of the Tibia comes into contact with the posterior tip of the Astragalus, establishing a new center of motion behind the line of the Malleoli. Continued movement ruptures the lateral and anterior ligaments. Thus the bones, being freed, the Tibia is pushed forward over the Astragalus, or the foot may be pushed backward under the Tibia, depending how the causative violence acts upon the leg or foot. The first step is a rupture of the ligaments, and the fixation of the Astragalus behind the Tibia takes place by correction of the Plantar flexion. The injury is commonly produced by a fall backward while the foot is fixed.

In clinical and post mortem examinations the lesions found were the same, fracture of the External Malleolus is common, and at times fracture of the Internal Malleolus and of the posterior articular border of the Tibia is seen.

In the front the foot appears shortened and the heel lengthened, to an extent conforming to the degree of displacement, about an inch being the maximum. The lower end of the Tibia projects and is more or less marked in front, and at times is exposed by rupture of the skin. The Extensor tendons can be felt, as tense cords crossing to the Dorsum of the foot, and the Achillis tendon curves backward to the heel, leaving on each side a marked depression between it and the Malleolus. The toes may be depressed, and perhaps abducted or adducted. The Malleolus accompanies the foot in its displacement backward if the Fibula is broken.

Dislocations Forward.—As in the preceding case, this dislocation displaces the Astragalus and with it the foot, but forward from beneath the Tibia. Cases of this character are much rarer than the preceding.

It may be produced by Dorsal flexion of the foot followed by impulsion of the Tibia downward and backward, by a force acting in the direction of its long axis, or by direct pressure of the foot forward and of the leg backward while they are at right angles to each other.

The symptoms are lengthening of the front of the foot and shortening of the heel. The depressions on each side of the Tendo-Achillis are effaced and the foot is in the position of more or less Plantar flexion. The hollow of the instep may be exaggerated, and the upper articular surface of the Astragalus can be felt in front of the end of the Tibia and also the Malleoli are nearer to the heel and to the sole than normal.

Dislocations Inward are those cases where, by adduction and inversion, the foot is moved downward and to the inner side so that the Astragalus leaves the Tibio-Fibular mortise more or less completely. There are two distinct forms, one in which the foot is markedly inverted and the upper surface of the Astragalus can be seen and felt raising the skin under the External Malleolus, and the other when the inversion of the foot is less or absent and there is marked adduction, sometimes causing the ends of the toes to point directly inward. The common cause is usually a fall from some high point.

Dislocations Outward are almost without exception those which are now commonly known as Pott's fracture at the ankle, and have been described in the previous chapter as fracture by eversion and abduction of the foot.

Compound and Complicated Dislocations of the Foot.—A dislocation of the foot may be compound, primarily or secondarily, also the bones of the leg or the Astragalus may protrude through the wound, and they may be complicated by rupture of the blood vessels and by fractures other than those of the Malleoli.

The wound of the skin in a dislocation that is primarily compound may be made from within, by the projection of the bone or by contact with the ground. In those that become secondarily compound the sloughing of the soft parts may be due to the pressure of the unreduced bones, or to bruising of the soft parts inflicted at the time of dislocation.

SUB-ASTRAGALOID DISLOCATIONS

Dislocation of the Astragalo-Calcaneoid and the Astragalo-Scaphoid Joints.

Those forms known as dislocations backward, inward and outward of the Os Calcis and Scaphoid from the Astragalus were recognized in Broca's plan of subdivision. Malgaine, an eminent French surgeon, added a fourth variety dislocations forward, and changed the nomenclature by treating the Astragalus as the dislocated bone, applying the terms indicative of the direction of the displacement in accordance to its position with relation to the others.

The dislocation thus presents four varieties: Displacement of the Os Calcis and Scaphoid inward and somewhat backward, with the head of the Astragalus projecting on the outer part of the Dorsum of the foot, their displacement outward and their displacement directly forward or backward and downward. The occurrences of the first two are of equal frequency and comprise the greater number of cases. The last two are of less frequent occurrence.

Dislocations Inward or Inward and Backward.—Forcible inversion and adduction of the foot combined with violence acting in the direction of the long axis of the leg as in a fall from some height are the usual causes. The displacement is very seldom, if ever, directly inward, but it is also slightly backward so that the head of the Astragalus rests partly upon the Cuboid.

Symptoms.—Shortening of the Dorsum of the foot and lengthening of the heel, adduction of the toes, elevation of the inner border of the foot, prominence of the tip of the External Malleolus and the head of the Astragalus on the outer side of the Dorsum with marked depression of the soft parts below each; the Internal Malleolus is deeply placed under the skin. Below and behind it can be felt the Sustentaculum Tali, and in front the inner surface of the Scaphoid.

Dislocations Outward.—There are two varieties and they are distinguished by marked abduction of the toes in one and absence in the other. In the former the posterior articular surface of the Astragalus is not separated from the Calcaneum, but the foot has turned upon the outer part of the Interosseous ligament as a center, the Scaphoid being carried to the outer side of head of the Astragalus, and sometimes is turned upward or downward. In the other form, without abduction of the toes, the foot is displaced bodily outward from beneath and in front of the Astragalus. The cause in the former appears to be forcible abduction of the foot, and in the latter it is either abduction and eversion of the foot or it may be great violence exerted against the inner side of the foot or the outer side of the lower part of the leg. It may be a primary or secondary compound, as the head of the Astragalus may project entirely through the skin.

Symptoms.—The form in which displacement is directly outward is a marked displacement of the foot, with little if any eversion or abduction. In the place of the usual prominence found by the External Malleolus and the head of the Astragalus there is a notable depression. The Internal Malleolus is very prominent and nearer to the level of the sole, and below and in front of it the head of the Astragalus projects. The Scaphoid, with a depression behind it, is recognizable on the Dorsum of the foot.

Dislocations Backward.—In this form the Calcaneum and Scaphoid are displaced directly backward, the Scaphoid descending to a lower level so as to lie under the head or neck of the Astragalus.

Dislocations Forward.—Only two examples of this form have been reported, one by Parise, quoted by Malgaine, the other by Broca. In Parise's case the patient was injured by being crushed under a heavy weight. The thigh was flexed on the trunk, the leg on the thigh, and the foot on the leg (Dorsal flexion). After a period of nine months this condition was as follows: The foot was at a right angle with the leg, somewhat adducted and very slightly everted. There was a displacement forward, making it appear lengthened in front and with the External Malleolus almost touching the Tendo-Achillis. On the instep the Extensor tendons were tense without palpable prominence beneath them, but on the outer side a bony prominence could be felt which was thought to be the Astragalus; immediately in front there was a depression which admitted the finger and the hollow between the Astragalus and Calcaneum appeared to be filled. The prominence of the heel behind was completely lost, the leg flattened and its surface interrupted at the level of and a little below the Malleoli, by a bony prominence which raised the Tendo-Achillis and overlapped the heel about half an inch; above this another less prominent being formed by the posterior articular edge of the Tibia. There was no trace of fracture or separation of the Malleoli. The motion in the Tibio-Tarsal joint was slight and in the joints of the Tarsus entirely lost. The patient required crutches to walk. The displacement in Broca's case was much less marked.

Total Dislocation of the Astragalus.—Dislocations of the Astragalus are usually compound and the varieties very numerous. They may be grouped as dislocations forward, backward, outward and forward and inward and forward, these terms indicating in which direction the Astragalus is displaced, and dislocation by rotation in which the bone remains within the mortise. The most common causes are falls from some height upon the feet or a violent twisting of the foot.

Medio-Tarsal Dislocation.—In this form the dislocation takes place in the Medio-Tarsal joint. The Scaphoid and Cuboid are together displaced from the Astragalus and Calcaneum which retain their relations to each other and to the bone of the leg.

DISLOCATIONS OF THE TARSAL AND METATARSAL BONES

The bones of the Tarsus may be dislocated separately and in various combinations.

Calcaneum.—The Calcaneum may be bodily displaced to the outer side without apparently being entirely separated from the Astragalus and Scaphoid.

Scaphoid.—The Scaphoid has been dislocated forward and outward in connection with the Astragalus, the dislocation being compound.

Cuboid.—One case reported by Bell in which the Cuboid was displaced upward in connection with the fifth Metatarsal by inversion and abduction of the foot.

Cuneiform Bones.—The three Cuneiform bones and the second and third Metatarsals have been displaced together; also the first and second Metatarsals have been displaced separately.

DISLOCATIONS OF THE METATARSAL BONES FROM THE TARSUS AND FROM ONE ANOTHER

The first Metatarsal is more frequently dislocated than the others, and the displacement is usually upward. The symptoms often indicate the co-existence of a sprain of the neighboring joints.

All the Metatarsals may be displaced together upward, inward, downward or outward.

Subluxation of the Head of a Metatarsal Bone.—As described by Morton the head of the fourth Metatarsal appears to be displaced from its normal relations with the adjoining one on each side, also with its toes; it is less frequent in the third.

DISLOCATIONS OF THE TOES

Metatarso-Phalangeal Dislocations—Dislocations of the Great Toe.—The cause most common is a fall upon the toe. It may be caused by kicking, receiving the weight of the body upon the toe; also by violence received upon the Metatarsus. The injury is usually compound. The dislocation appears most frequently to be on the outer side and backward, and secondly those directly backward, the former being always compound with the head of the Metatarsal bone projecting through the wound on the inner and lower aspect of the joint. It also has been upward and backward to one side. Sprain or subluxation of the first Tarso-Metatarsal joint has often been noted.

Dislocations of the Other Toes.—The four outer, the four inner or all of the five may be displaced upward and backward or directly outward.

Dislocation of the Phalanges.—The dislocation most frequent is that of the Terminal Phalanx of the great toe.

CHAPTER XXXV

CORNS (CORNU, HORN)

In this chapter it is proposed to touch briefly on Corns, Bunions and Callosities known to result from the unequally disposed pressure of ill-fitting boots and shoes and other removable evils.

In dealing with corns it is well to know that there are several varieties of corns, such as hard and soft corns, suppurated corns and Nervo-Vascular corns. They may be defined as follows:

Hard Corn.—A horny induration and thickening of the skin, produced by friction and pressure; a conic mass is formed that extends down into the derma, causing pain and irritation.

Soft Corn.—A soft thickening of the epidermis between the toes, which is kept soft and irritated by the moisture and pressure of the toes.

Suppurated Corn.—Similar to hard and soft corn, but accompanied by pus and infection.

Nervo-Vascular Corn.—Forms on toe joints or where the skin is unusually vascular.

Vascular Corn.—A deep seated or vascular substance, forming a circumscribed tumor in which the papillary capillaries have obtruded themselves beyond their normal place, and is found on the sole or heel of the foot. The conditions of the formations described above are often modified and are known as blood corns, warty corns, neuro-fibrous or nerve corns, laminated, ulcerated corns and festered corns, etc. But these terms merely apply to conditions arising in the course of development and usually denote a symptom or somewhat altered appearance of those which are true corns. These corns are often a source of great pain, their formation creating a pressure which gives rise to pain of various gradations, from a dull pain to that similar to a toothache. The pain is intensified by climatic changes, and it is an undisputed fact that on the approach of a rainstorm or in a humid atmosphere the pain in the feet of those who suffer from corns is increased. Corns result from pressure and friction and are caused by tight or loose and ill-fitting shoes.

CHART No. 167
Foot Covered with Hard Corn Growths.

HARD CORNS

Hard Corn is a small conical shaped, deep-seated horny formation usually found about the toes, the apex of this formation pressing down upon the corium of the skin. They range in size from a pin-head to the size of a pea. Although these growths are more frequently

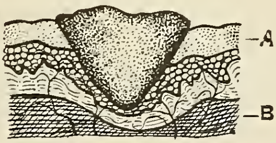


CHART No. 168
Showing Hard Corn Pressing Down into Skin. A, Epidermis; B, Derma.

found on the foot they may appear on any part of the body where pressure or friction is maintained. The most common variety is Hard Corn and its structure is hard and is usually found on the Dorsum of the foot.

Chart No. 169
Corns on Second and Fifth Toe and on Bunion Joint.

Chart No. 170
Corns on Second, Fourth and Fifth Toe.

The *hard* corn is formed by friction rather than by pressure. The process has been thus described: "The hard corn is produced by the

Chart No. 171
Felt Kiro Pads Applied with Adhesive Plaster.

constant pressure and friction of a tight or small shoe or a large shoe against the projection point of some prominent bony surface, as on

Chart No. 172
Medicated Corn Plaster with Pad Applied to Toe.

the last joints of third, fourth and little toe. If the action is kept up, a sense of pain is experienced, which produces inflammation; rest decreases this inflammation, leaving induration behind it. Renewed action from the preceding causes reproduces the same effects, in-

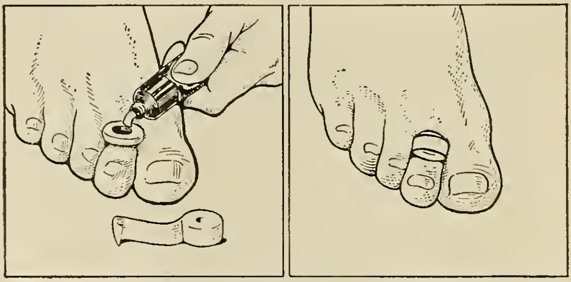


CHART No. 173
Applying Pedico Corn Salve Inside of Felt Pad. Pad in Place Covered with Tape.

flammation again ensues which in its turn is equally decreased either by rest or a temporary removal of the cause, leaving behind a second or accumulated degree of induration.

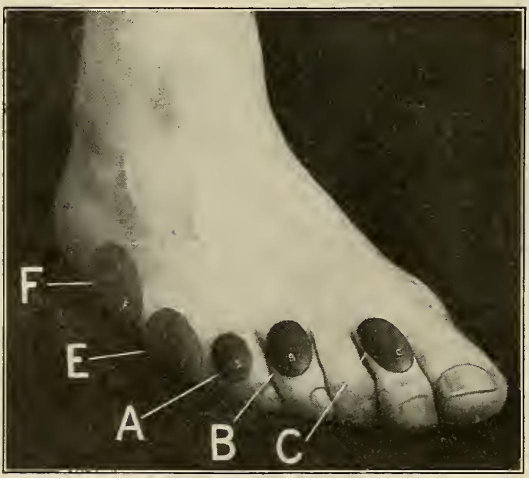


CHART No. 174
Rubber Pads for Corns, Hammer Toes and Tender Joints.

Very frequently extraordinary friction is produced against the toe where the foot is crowded and forced into the toe of the shoe, caused by a weakened arch. This can be relieved by fitting a light arch support or foot-eazer that will hold up the arch and draw the foot back and hold it there.

This continued action and reaction bring on a collosity rising above the surface of the skin, which increases from its bases in proportion to the excess or diminution of the exciting cause. Once formed, pressure alone will suffice to sustain it."

CHART No. 175
Showing Zin-Ox Water-proof Healing Pads.

Treatment.—An ordinary hard corn of recent formation may be removed by scraping off the callous skin around its border and removing it carefully with a knife, taking care that the under skin is not cut through. In doing so, all septic precautions must be observed and a special corn knife should be used. This operation is exceedingly dangerous in the hands of an inexperienced operator.

Corn removers which contain such as salicylic acid and cannabis indica with flexible collodion or in an ointment base are universally used and at times afford relief by continued application, but three forms that have been used with much success and advocated by me to remove hard, thickened growth are known as pedico corn salve, two-drop liquid corn remover and fixo medicated corn plaster.

As a preventive measure to remove pressure from the conical-shaped growth known as hard corns, pads made from layers of oxide of zinc plaster, cut to the necessary oval shape with a heavier

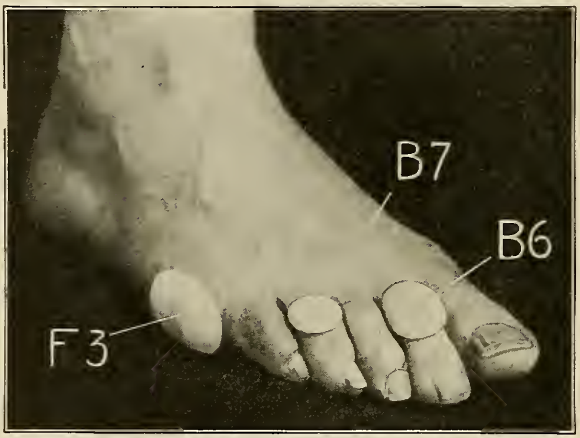


Chart No. 176
How Pressure is Removed by Kiro Pads.

outside shoulder for protection, prove very useful. Pads such as those described above, cut in various shapes, are on the market ready for use and are known as zin-ox pads, which make a convenient water-proof, antiseptic and healing protection.

Felt skived pads in oval, round and concave shapes are very beneficial in protecting the parts from pressure of the shoe. Author's kiro pads, consisting of live wool felt automatically skived to many shapes and thicknesses, also afford relief, and are especially beneficial after the corn has been removed.

Pads of rubber and gutta percha, moulded in sizes and shapes to conform to the shape of toes or affected parts, having an outside border or shoulder and conical opening to fit over the corn, will remove the friction and pressure. These pads thus made and used by me are known as absorbo pads. By relieving pressure and maintaining the body warmth the skin secretions are promoted, consequently causing the horny, callous growth to separate from the healthy tissue.

SOFT CORNS

Soft corns are always found between the toes and are kept continually moist by the excretions between the toes. They never become hard like those found on the top of the toes. They are not deep

Chart No. 177
Toe-Right for Soft Corns.

seated and do not project above the surrounding surface. They are constantly subjected to pressure which keeps them flat. Soft corns are nearly always present where the Metatarsal bones have become slightly displaced, which forces the Phalanges of the toes against the other members. They are usually caused by pressure of the joint of an adjacent toe against the one where the corn is formed. If the pressure is very severe it may produce inflammation, which ends in suppuration.

The first sign of a soft corn is a feeling of burning between the toes: a blister soon forms and the escaping exudation irritates the surrounding skin. If the blister does not break, the fluid hardens and forms the corn. When the exudation escapes, the skin becomes inflamed and new thick layers take the place of the cuticle, and the corn is formed. When the corn reaches its growth it produces a feeling as though there were a grain of sand or a small pea between the toes.

When a soft corn commences with severe inflammation, the skin becomes thickened and a corn is formed at the point where pressure is greatest. It shows a circular form and a dirty red or light brown color. If the corn is neglected, ulceration sometimes follows, causing inflammation of the entire foot, and may also extend to the leg attended with severe pain.

Sometimes a soft corn will show a white spongy thickening of the skin. It may at times appear as a white spot or like a split pea. It may also show a white thickening of the skin rising into a pustule. With an opening in the center, sometimes a soft corn forms at the inner side of the great toe and near the end of the second toe. In old people whose feet show little moisture, the corn is harder than usual.

Treatment.—First remove the existing cause. If produced by dropping of one of the Metatarsal heads, fit the patient to Anterior Metatarsal arch supports to correct. Then thoroughly cleanse the parts, dust with antiseptic powder and apply a toe-right to separate the toes. Stockings and shoes should be looked into.

SUPPURATED CORNS

Corns situated on the tops of the toes near prominent joints are found to suppurate when severe pressure or irritation is exerted. They may be either hard or soft. The first symptom is indicated by redness over the joint and the toe is extremely sensitive to the slightest pressure, inflammation sets in and pus forms under the corn and in the bursa beneath. when the corn is extracted it generally has a part of the bursal sac adhering to it, sometimes the bursa is diseased. Without any thickening of the outer skin the only external appearance is the redness and swelling to the toe with a small white spot, having a minute speck in the center. Later they will fester, and pus bacteria are present, with swelling and intense pain.

Treatment.—Parts must be thoroughly cleansed with a reliable antiseptic, and padding applied. After suppuration ceases, a healing salve should be applied with a pad to protect from further pressure.

NERVO-VASCULAR CORNS

Nervo-vascular corns form in the toe joints of persons whose skin is unusually vascular; they easily become inflamed from pressure. When these corns become developed, the skin covering them is slightly thickened and semitransparent. They have villi or nervous fibres running in zigzag whitish lines within the induration, small corns appearing between them like white specks corresponding in the form to the cells they occupy, although the outer skin of these corns is no more sensitive than any other thickening. The nervous filaments are so sensitive that the slightest pressure of a shoe can hardly be borne and in operating on these corns a great deal of pain is caused. This species of corn is caused by more severe pressure on the part than is necessary to cause the ordinary corn; therefore a more severe inflammation is caused, so that the true skin, subject to compression, participates and is vascular, and the nerve fibres become enlarged to a great extent.

When the inflammation has been reduced to some extent by means employed by the patient, the enlarged structures do not return to normal, but constitute a network in whose meshes is deposited the matter produced by the thickening of the skin, that is continually going on, which, becoming condensed, forms the small corns situated between the nervous fibres. By the time the inflammation has entirely ceased, these nervous filaments are completely matted within the outer skin.

Treatment.—The treatment consists of applying salicylic soap plaster. Then apply an absorbo pad or a thin felt kiro pad to remove pressure.

VASCULAR CORNS

Vascular corns are very painful. They are generally situated on the sole of the foot, upon the plantar muscle, or the under side of the heel, also on the little toe, and sometimes on the sides of the large toe close under the nail. They are easy to tell from a common corn, having more the appearance and character of a wart, but they cannot be called warts, as warts are found mostly on the hands and fingers and on parts where there is no pressure. Warts are seldom painful and grow without apparent cause. Vascular corns are always painful, and are never produced without previous irritation.

This corn consists of a deep-seated spongy or vascular substance, forming a circumscribed tumor and does not project much beyond the level of the thickened skin. When developed its whole surface is studded with red and black specks and the surrounding integument is inflamed and swollen. In some cases these minute extravasations are not distinctly defined. The corn then appears as a softened tuft; the vascular fibres of which it is composed seem to be of unequal length. When an attempt is made to remove this corn with a knife. hemorrhage follows to a considerable extent, all of the minute vessels pouring forth their contents very profusely. I have never seen a case that presented any malignant symptoms; they always yield readily to proper treatment, and the disease rarely, if ever, returns. In most of these cases you will find the flesh of the feet moist and clammy and the skin thin. It is not prevalent in children under ten years, or in aged persons. It is more common in men than in women.

In the first stages it is characterized by a burning sensation in the part affected and is very sensitive to pressure and attended by an aching, throbbing pain, particularly after walking, when the shoe has been removed and on lifting the foot from the ground. It is always hard to find a satisfactory cause for this complaint.

Treatment.—Owing to complications which may arise, these conditions should be treated by cauterization at the hands of a surgeon.

CHAPTER XXXVI

CALLOSITIES—CALLOUS

Callous is a thick, hardened area of skin, usually caused by pressure or friction which causes an excessive accumulation of corneous or horny layer, and a congestion of the pores of the skin, occurring most frequently on the soles of the feet. Callosities are acquired

CHART No. 178
Callouses on Sole Caused by Metatarsalgia.

formations and present areas of various sizes and of a gray or yellow color. Beyond the thickening, no other material alteration takes place on the cuticle, for the numerous lines and furrows of the skin can be seen in continuation of the normal integuments. This hard-like and horny formation is frequently caused by long continued friction or pressure, although occasionally produced by extreme cold. Wearing of improperly made shoes is the prevailing cause, which allows the foot too much space or expansion to move about, consequently rubbing upon some uneven spot or prominence on the inner sole. Callosities

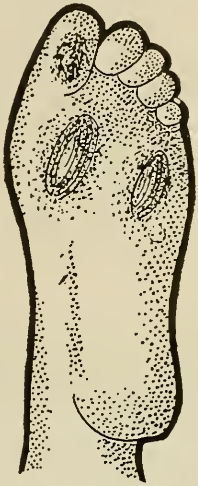


CHART No. 179
Callouses on Sole.

in this case are usually very large, extending over the part subjected to friction. In most cases the sensitive places are usually found at the ball of the great toe, lateral surface of the little toe, at the heel

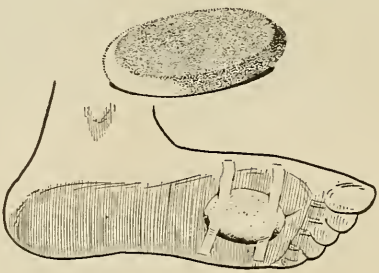


CHART No. 180
Kiro Pad for Callous on Sole.

and over the heads of the Metatarsal bones. Inflammation is not known unless when infected. Callosities may also occur as a result of chronic skin diseases, such as psoriasis, eczema, ichthyosis, etc.

CHART No. 181
Applying Felt Kiro Pad with Cedar Plaster.

CHART No. 182
Finger Pointing to Thick Callous Over Second and Third Metatarsals.

Callouses on the sole are most prevalent and are usually caused by pressure and friction on the Metatarsal heads which go to form the Anterior Transverse arch. At this point the protective tissue is very light and the parts are easily irritated.

CHART No. 183
Skived Felt Kiro Pads Used for Callouses.

Callosities on the heel and instep are not as a rule troublesome and are easily cured by being relieved from pressure and friction.

Treatment.—The treatment consists in first removing the cause, then relieving the pressure on the irritated parts. Examine the foot

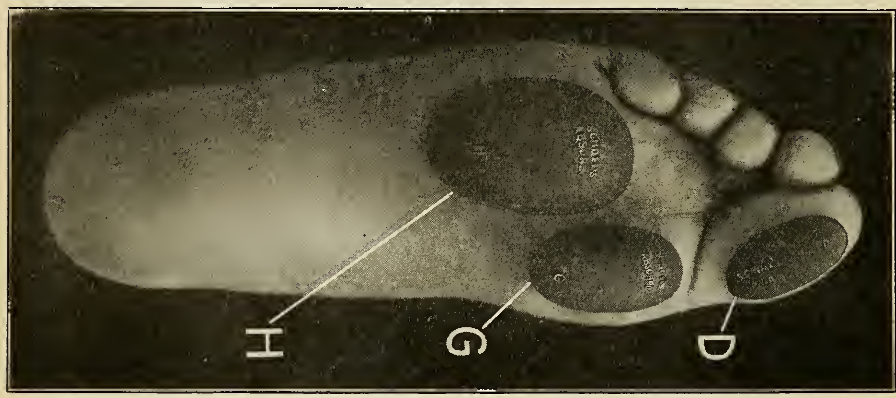


CHART No. 184
Rubber Pad for Protecting from Pressure Callouses on Bottom of Feet.

carefully to learn if the callouses form over the Metatarsal heads; fit the patient with a pair of Anterior Metatarsal arch supports without the flange to relieve pressure and distribute the weight. Where callouses are thick and of long standing apply pedico callous salve, using absorbo pads or kiro pads to protect and remove pressure.

CHAPTER XXXVII

INGROWING TOE NAIL

Ingrowing Nail is a condition in which the lateral edge of a nail has become imbedded in the adjacent soft parts of the lateral nail groove and giving rise to an inflammation of the matrix and soft parts about the nail.

CHART No. 185
Ingrowing Toe Nail.

In describing a nail it is well to understand that the nail is a part of the epidermis, which consists of epithelial scales, which are modified to form the nail cell and are joined together in a horny, elastic substance to give strength to the ends of the toes.

The cells of the nail, like those of the epidermis are derived from the true skin, which in this part is called the matrix or root of the nail. The cells are produced at the root of the nail and pushed forward to supply wear and tear at the end.

It is most frequently found on the large toe, although it may appear on any of the other toes, but less severely. It may be caused by improper cutting of the nail, or by the wearing of shoes too narrow across the toes, which force the flesh against the sides

Chart No. 186
Cut of Nail Spring, Etc.

of the nails, which subsequently causes the part to become inflamed, swollen and very painful. Walking increases the inflammation, which may result in ulceration along the entire nail groove. Under improper treatment or negligence it will continue for some time until the whole area is covered with proud flesh. The pain becomes so severe that the patient cannot without much pain sustain the weight of the body upon the foot or toe and is compelled to rest. All pressure, such as pointed and narrow shoes or stockings occasion, should be removed; also the irritation caused by the pressure of the side of the nail. The latter may be done by introducing a small piece of cotton under the edge of the nail and between it and the swollen parts with a probe or a pointed piece of wood. Surgical treatment consists of removing that part of the nail creating the irritation.

The mechanical treatment consists of applying a sterling silver nail spring to the inverted parts of the nail, and the use of an astringent and healing remedy to destroy the proud flesh and create a healthy granulation of the affected area. Then it is very important to remove the exciting cause, taking care to protect the affected parts from pressure of any nature, and to wear stockings of sufficient length and shoes with soft and wide toes.

OTHER ABNORMAL NAIL CONDITIONS

Onychauxis is a condition of hypertrophy in which the nail is overgrown. It may be in the dimensions of length, thickness or width, or all combined, and is accompanied by changes in color, texture and shape. At times the hypertrophy is lateral and the condition is known as ingrowing nail, and causes an inflammation of the surrounding soft parts (paronychia). At other times the nail becomes bent at the distal end, due to the excessive growth, and is known as onychogryposis.

Onychia is an inflammation of the matrix of the nail, and is characterized by pain, swelling and the formation of pus under the nail. The nail may eventually be destroyed, exposing the surface, which is highly inflamed and suppurative.

This condition may be produced by traumatic causes, syphilis, tuberculosis, eczema and other skin diseases, which may cause pus infection.

Syphilitic Onychia is not often seen on the toes, and is usually accompanied with syphilitic eruptions on other parts of the body.

The matrix of the nail frequently turns red; there is swelling, suppuration and ulceration. The entire extremity of the toe becomes enlarged and the skin around the nail becomes swollen, while the suppuration increases, partly overlapping the nail, giving an appearance of an ordinary ingrowing toe-nail. The nail also may become discolored, brittle, altered in thickness, rough, and at times falls off. The local affection disappears and readily yields to systemic treatment. Sometimes onychia assumes a malignant form, causing severe pain and destruction of the Periosteum, with disease and perhaps necrosis of the bone. This condition may occur with no apparent cause either local or constitutional, but probably is a result of malassimilation or some other bad condition of the parts.

CHAPTER XXXVIII

SKIAGRAPHY

The use of X-rays in diagnosis is without a doubt indispensable. They are the means of locating fractures and dislocations, tumors, foreign bodies and diseases of the bones. In recognizing internal dis-

Chart No. 187
X-Ray Showing Foot with Spreading of Transverse Anterior Arch.

eases the X-rays have proved themselves exceedingly valuable in many instances, and again facilitating and eliminating many of the dangers associated with the same. There are cases in which from the nature and location of the pain a true diagnosis can be made, but frequently many errors occur. Thus what heretofore was conjecture is now replaced by certainty, as the X-ray enables us to obtain a perfect picture of the existing conditions.

CHART No. 188
X-Ray Same Foot in Shoe. Note Crowding of Metatarsals as well as Bones of Toes.

As the radiograph of a suspected foot aids materially in diagnosis, it is advisable if possible to obtain one before a positive diagnosis is made. By a skiagram many obscure cases are cleared up. A poor one is worse than useless, as it is likely to mislead. In taking a skiagram of an abnormality it is usually necessary to take two or more views of the object before a satisfactory one is obtained. A fracture may not show from one side, but may be perfectly clear from the front, or vice versa. To note possible changes which may

Chart No. 189
X-Ray of Child's Foot,
Normal.

take place after the interval it may be necessary to repeat the skiagram. Diminished density (bone rarefaction) on the affected side

Chart No. 190
X-Ray Showing Foot of Woman, Poised for High Heel Shoe, with Dropped Metatarsals

in a skiagram denotes the beginning of a bone disease, and when the bone disease recedes the skiagram will show increasing density before the improvement is evident.

In taking a skiagraph of the joints, particularly the hip, they may appear in the plate to be ankylosed, but as a matter of fact considerable motion is present. Bony ankylosis can be proved in a skiagraph, by tracing from bone to bone the individual striæ or lines. In a skiagraph of arthritis deformans, lessened joint interval (condensation of cartilage), bone atrophy and probably osteophytes. In cases of a dislocated hip, or Coxa Vara, the skiagraphs are usually obvious. It is advisable to take corresponding parts that a comparison may be made. In a skiagram of a diffuse tuberculous bone, infiltration is not shown.

In order to make proper deduction and correctly interpret X-ray plates the operator must be thoroughly versed in surgery and particularly familiar with the anatomic structure of the body, including centers of ossification and congenital deviations.

CHAPTER XXXIX

HISTORY OF FOOTWEAR

Footwear of the Ancients B. C. 53—A. D. 450.

In the preparation of this chapter many old-time books were consulted so that an understandable history of shoes might be obtained.

Shoes were no doubt the result of necessity to form some means of protection to the feet, but in later years were used more exclusively for the style they afforded.

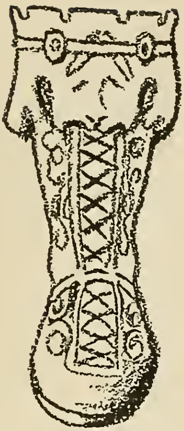
The ancient Egyptians, who possessed all the peculiarities characteristic of the Negro conformation, seem to have gone nearly naked, and in many representations of personages of both sexes the whole upper part of the body appeared entirely naked, or adorned only with a profusion of necklaces, belts, armlets and bracelets, while an apron wrapped around the loins descended like a petticoat to the ankle.

The Asiatics often wore half-boots laced before with four long, depending flaps, probably formed out of the legs of the animals whose skins were converted into these buskins.

Eastern personages frequently appear in shoes or slippers, but seldom if ever in mere sandals that leave the toes bare like those worn by the Greeks.

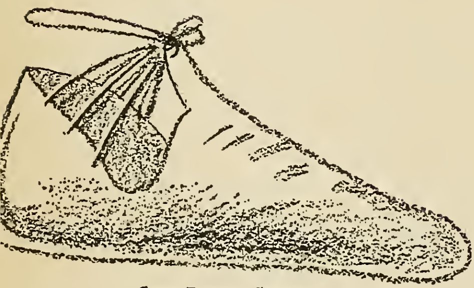
In the Old Testament frequent mention is made of shoes: Thus God commanded Moses, "Draw not hither; put off thy shoes from off thy feet, for the place whereon thou standest is holy ground."—Exod. III. 5. It is known that to this day the Oriental removes his shoes on entering his house of prayer.

In the books of Deuteronomy, Joshua, Ruth, in the Psalms, in Amos, and in other parts of the Bible, there are chapters informing us that sandals and shoes of rushes or of leather, of beautiful work-



Roman Buskin Worn from 55 B. C. to A. D. 450.

Greek Sandal.



Gallo-Roman Sandal.

Greek Sandal.

Roman Sandal.

Bohemian Child's Shoe.

Chart No. 191

manship, were commonly worn by the Egyptians. We have also ample proof by the splendid examples exhibited in the Egyptian department of the British Museum.

Footwear of the Greeks and Romans.

Taking a long stride from the remote to that of the Greek and Roman, and later to the medieval era, we find the art of shoe and sandal making continues to play an important part in the civilized world.

The feet of the ancient Greeks frequently were left entirely bare, sometimes protected underneath by a simple sole tied with thongs or strings disposed in a variety of elegant ways across the instep and around the ankle. They were often shielded above by means of shoes or half-boots, laced before and lined with the fur of animals of the feline tribe, whose muzzles and claws were disposed in front.

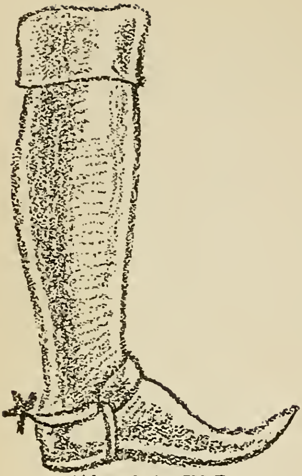
The Romans had a great variety of sandals, the greater portion being similar to those worn by the Greeks, one kind covering the whole leg, called Ypodementa; in the Greek and in the Latin by several names, viz., calceus, mulleus, pero and phæcosium.

Another variety known covered only the sole of the foot, and were made of leather or other materials. These were called by the Greeks pedita, but were demonstrated in various ways by the Romans as caliga, solea, campagus, baxea, sandalium, crepida and sicyonia. To all the term "calceus" was invariably applied.

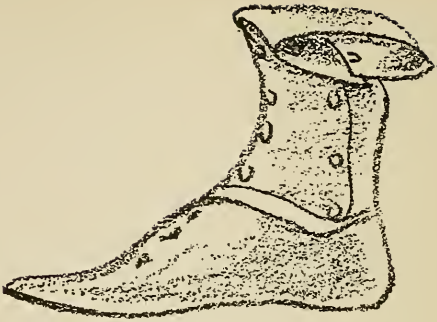
A shoe, usually of a scarlet color, but sometimes purple, called "mulleus," was forbidden to be worn by the common people.

The phæcosium, a light thin shoe, was worn by the priests of Athens and also by the Romans. It covered the entire foot and was made of leather.

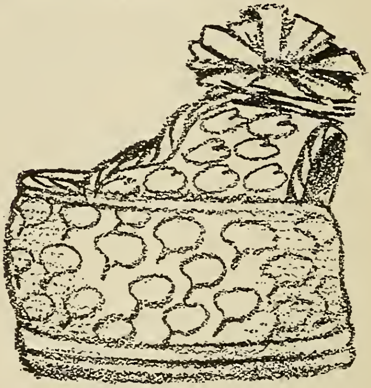
The shoes worn by the people of ancient Latium were made of untanned leather, and in later times were worn by the rustic people of the lower classes. This type of shoe was called the "pero." The campagus and the caliga were sandals, worn by the military. The sole of the latter was large and strengthened with nails, and chiefly



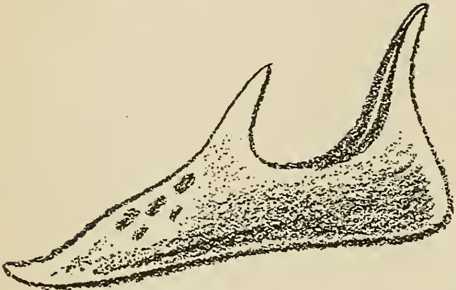
Edward the IV Boot.



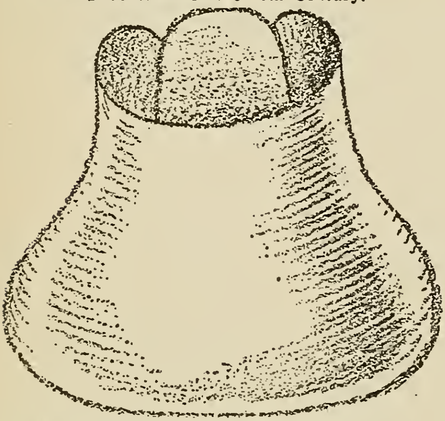
Shoe of the 12th Century.



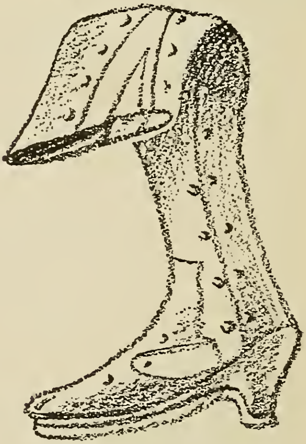
Chopine or Tall Clog, the Sole is 2½ inches Thick and Made of Cork.



Shoe Worn in the 12th Century.



A Wide-Toed Shoe of Henry the VIII Time, Without the Heel Piece. This Fashion Prevailed with the Military in the Steel Soleret. It Measures 9 inches in Length and 6 inches Across the Toes.



A Riding Boot or Buskin. This Undoubtedly Belonged to Queen Elizabeth.

CHART No. 192

appropriated to the common soldiers. The campagus was worn by the emperors and generals of the army, it differing little in form from the caliga, but the ligatures were more closely interwoven with each other and were more often crossed over the foot, producing a resemblance of network. The Emperor Gallienus wore the caliga ornamented with jewels in preference to the campagus, which he scornfully described as nothing but nets.

The caliga, the crepida, and of course the sandalium, were all of these species of sandals fastened about the feet and ankles by fillets, or thongs, but though each had its peculiarities it is at this late date impossible to ascertain them. The solea, we are informed, could not in strict decorum be worn with the toga, and it was considered effeminate to appear in the streets of Rome with them. However, regardless of this rule, the Emperor Caligula not only wore the solea in public, but permitted all who pleased to follow his example. The baxea, also of the sandal kind, was originally worn, according to Arnobius and Tertullian, by the Grecian philosophers, and as it appears from the former author, was manufactured from the leaves of the palm. Here Plantius notices the baxea, but nothing respecting their form is specified. Cicero tells us the sicyonia was used in races, and from this we infer it must have been a very light kind of sandal.

Lucian speaks of it as being worn with white socks. A shoe or sandal called the "gallica" was adopted from the Gauls, but was forbidden to be worn with the toga, and to these may be added the saulponeæ, worn by the country people; also the solea, a shoe with soles of wood called in Latin *solea ligneæ* (wooden sole), used by the poor.

Of household words which occur in the catalogue of Roman footgear two names are familiar, the sock and the buskin. The sock, or "soccus," as it was called, is stated to have been a plain kind of shoe, amply large enough to receive the foot with the caliga, crepida or any other kind of shoe upon it.

The buskin (cothurnus) was anciently worn by the Phrygians and the Greeks, deriving its reputation from being introduced to the stage by Sophocles in his tragedies. It was a boot laced up the front of the leg, at times covering the toes entirely, and at others a stay passed between the great toe and the next connecting the sole with the upper portion, which met together over the instep and were from this point laced up the front similar to half-boots worn at present.

The cothurnus was worn by both sexes in Rome, as they were in Phrygia, but from the circumstances mentioned above it has especially been associated with tragedy.

The soccus was worn by the comic actors because in like manner it was typical of comedy.

Socks, or covering for the feet made of wool or goat's hair, called "udones," were used by the Romans, but the men who wore them were regarded as effeminate.

Painted shoes of various colors, often sumptuously adorned with gold, silver and precious stones, were worn by the wealthy. Emperor Heliogabalus had his set with diamonds interspersed with other jewels.

Emperor Amelian did not favor painted shoes, considering them too effeminate for men, and therefore prohibited the use by them of the mullei, which were red, white, yellow and green.

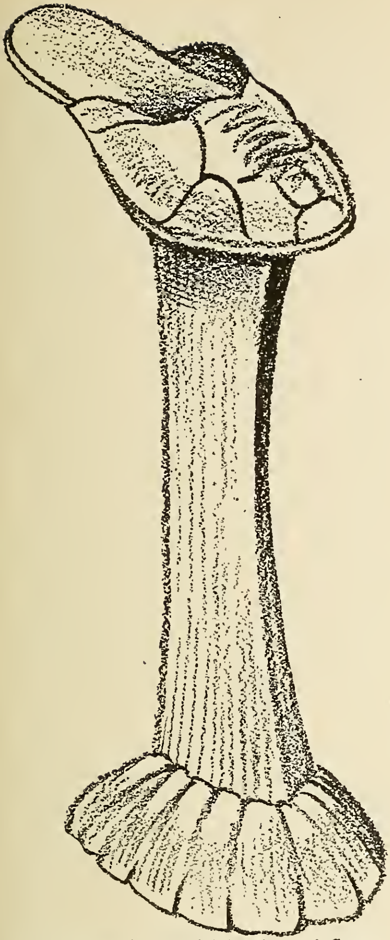
The latter he called "ivy leaf colored" calcei hidracei, a type of shoe turned up, and with pointed toes called calcei repondi, or bowed shoes, a fashion adopted from the East; and subsequently carried to such extravagance in the middle ages.

Black leather boots reaching from the middle of the leg are said to have been worn by the senators from the time of Casus Marcus. (See chart No. 191.)

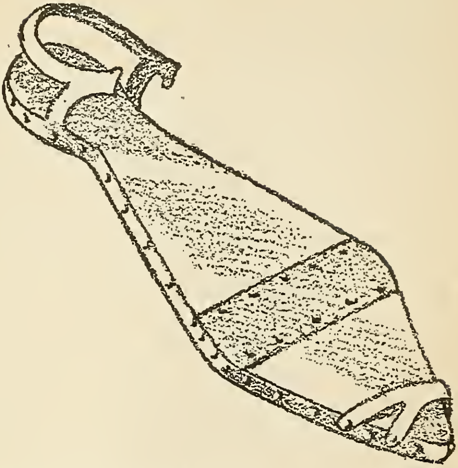
Footwear of Anglo-Saxons.

There is nothing more interesting in the history of civilization than the varying changes in dress and fashion.

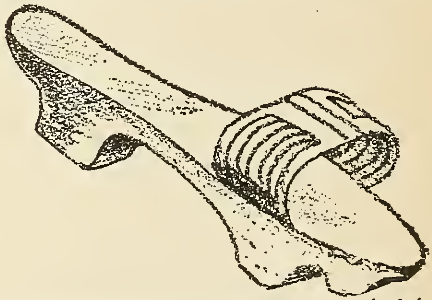
After the dissolution of the Roman Empire, the different tribes who settled in its provinces appear in general to have adopted the civil costumes of the conquered Romans, while they probably re-



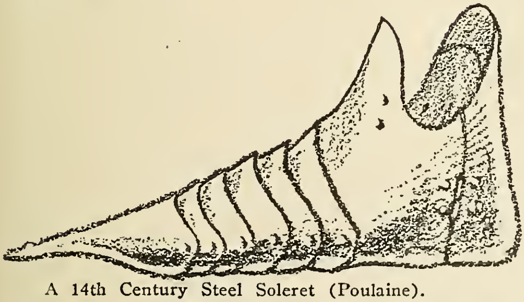
A Chopine for the Right Foot of Coarse Workmanship. The Sole of This is Made of Layers or Blocks of Cork, the Center Being Hollow.



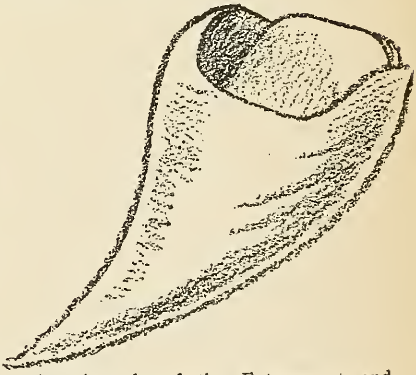
A Wooden Patten Made of Two Flat Pieces Overlapping in the Center and Hinged with Leather. It is 10½ inches in Length and 2 inches at the Widest Part of the Sole.



A Wooden Patten 10¼ inches Long and 3¾ inches at Its Widest. Worn During 14th and 15th Centuries.



A 14th Century Steel Soleret (Poulaine).



An Example of the Extravagant and Singular Fashion of the Shoes of the 14th Century.

CHART NO. 193

tained with tenacity the arms and military customs of their forefathers. There was a general resemblance between the dress of the Anglo-Saxons, the Franks, and other nations of the West. In the manuscripts the form of shoes as represented is nearly uniform. They cover the foot to the ankle, are tied with a thong, having an opening down the instep, and are usually painted black, except those worn by the princes and great persons, who had them frequently gilt or covered with gold.

Anglo-Norman Footwear 1060-1200 A. D.

The civil costume of the Anglo-Normans at first did not differ widely from that of the Anglo-Saxons, their shoes being almost similar. Near the end of the century shoes were constructed differently, being profusely ornamented. Knights and people of fashion wore long, pointed shoes, which were often turned up at the points.

Long pantaloons with feet to them, with shoes or sometimes short boots, were worn by the middle or lower classes.

Shoes Worn in the Thirteenth Century.

The shoes worn in the Thirteenth century were long-toed, and among the rich they were very elaborate, being elegantly embroidered in fretwork.

Shoes Worn in the Fourteenth Century.

On the character of the costume the reign of Henry VI. has nothing very decided. It may be regarded as a period of transition between the reign of Edward I. and that of Edward III.

The dress of the male continued much the same as in the preceding reign, except that near the end of this reign it was distinguished by the accumulation of finery which became so obnoxious to the reforming lollards in the latter part of this century. It appears that many fashions of this reign have been brought from Germany. The footwear, as described by a contemporary writer of the time, is thus:

"Their shoes and patterns are snouted and piked more than a finger-long bending upward, which they call crakowes, resembling the claws of devils, and fastened to the knee with chains of gold and silver." (See Chart No. 193.)

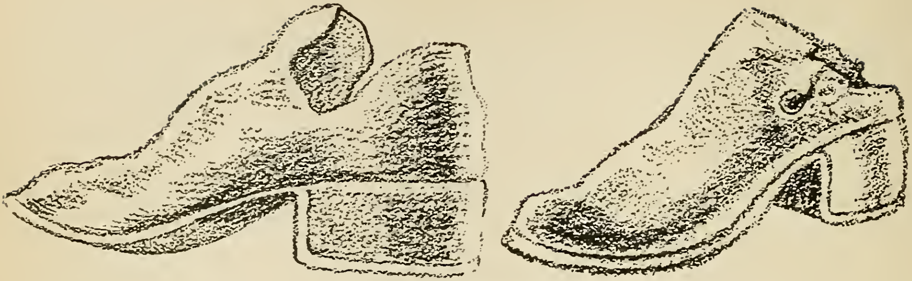
Shoes Worn in the Fifteenth Century.

After Henry the IV. acceded to the throne various attempts were made to reform the extravagant fashions and expensive apparel worn in the preceding reigns, severe sumptuary laws being repeatedly enacted, but with only partial success. With the reign of Henry VI. we enter a new period of the history of costume.

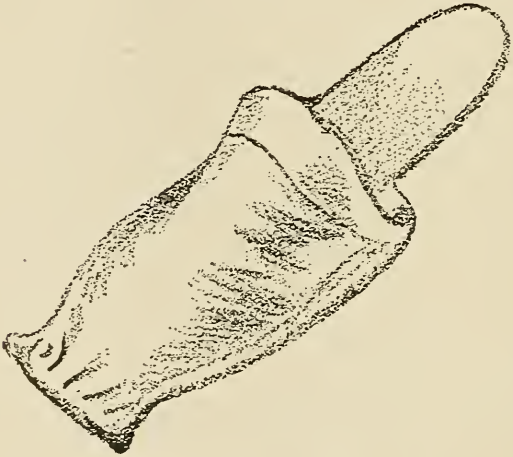
The principal characteristics were long, tight hose with feet, and sometimes short boots or buskins, after boots reaching to the middle of the thigh called galoches; or very long-toed shoes with high fronts and backs that turn over each way. At no period of the Fifteenth century was the extravagance of dress more remarkable than during the reign of Henry VII., but the most remarkable characteristic of the latter part of this century was the extreme broadness of the toes of the shoes, which suddenly usurped the place of the long, pointed shoes of the preceding reigns.

Paradin, an old French writer, describing the manners of this century, says that at first "Men wore shoes with a point before half a foot long; the rich and more extravagant personages wore them a foot long, and princes two feet long, which was the most ridiculous thing that ever was seen; and when men became tired of these pointed shoes, which were called poulaines, they adopted others in their places which were named duck-bills, having a bill or beak before of four or five fingers in length. Afterward assuming a contrary fashion, they wore shoes so very broad in front as to exceed the measure of a good foot."

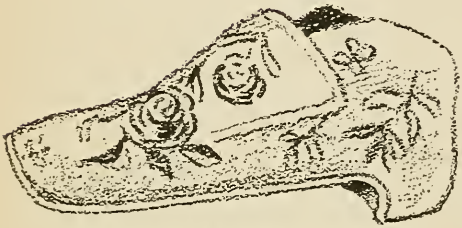
The shoes of the ladies during this century were made so small that they could hardly walk in them, frequently causing their feet to be made lame, sore and full of corns. This condition was described by a French moralist as being "the greatest evil of the age." In the



Shoes of Charles the First.



A Square Toed 15th Century Black Leather Shoe Minus the Heel and Side Leather.



The Left Shoe of a Handsome White Satin Pair which Belonged to Queen Elizabeth.

A Shoe of Elizabeth, Queen of Bohemia, 17th Century.

CHART No. 194

reign of Henry VIII. we enter upon an entirely new period of costume and art, differing in every possible respect from the preceding ages. In this reign the former splendors of the feudal baronage were disappearing, and the gorgeous pageantry of the Roman church was on the point of being abolished; thus it was in this century under Edward VI. and Mary that shoes similar to those of the present came into vogue. (See Chart No. 194.)

Tudor Period, Sixteenth Century.

During the Tudor period the common form of footgear was the low shoe with a big Tudor ribbon rose. Another kind of shoe for outdoor wear excited the merriment of those who held aloof from the new fashions because it caused the wearer to shuffle. This shoe was called the "pantofle," and originally was a much plainer kind of shoe to be strapped over the other as a protection.

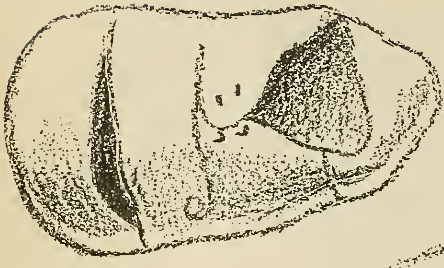
The pantofle was a modified form of the "chopines," being worn in Italy at this time, and ladies' high-heeled shoes in England were frequently called chopines. Coryate describes the Italian chopine as follows: "Of a great height, even half a yard high; and by how much the nobler a woman is, by so much the higher are her chopines. All their gentlewomen, and most of their wives and widows that are of any wealth, are assisted and supported either by men or women when they walk abroad, so that they may not fall."

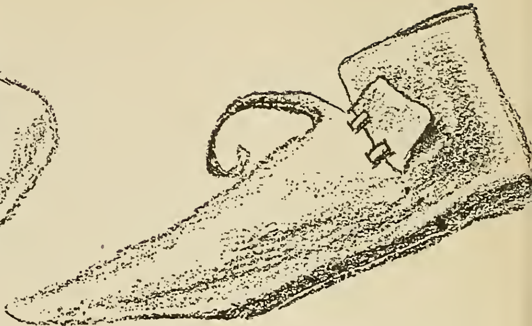
It is said that English ladies never wore any such absurd articles, though the heels to their slippers were extremely high and unsuited to pedestrian exercise.

There were in vogue more comfortable shoes, and one of the Tudor princesses had black velvet buskins, or short boots, lined with fur. (See Chart No. 195.)

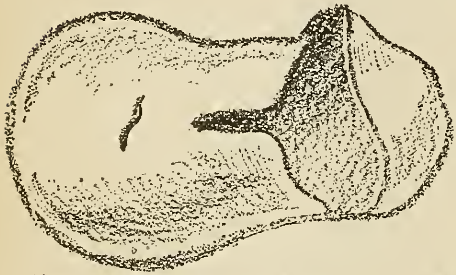
Stuart Period of the Seventeenth Century.

Boots appear to have been generally worn by all classes of society under the Stuarts, and thus the Spanish Ambassador Gondemar said to James, "I shall amaze my countrymen by letting them know at

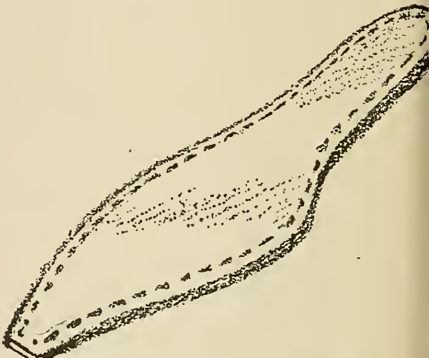




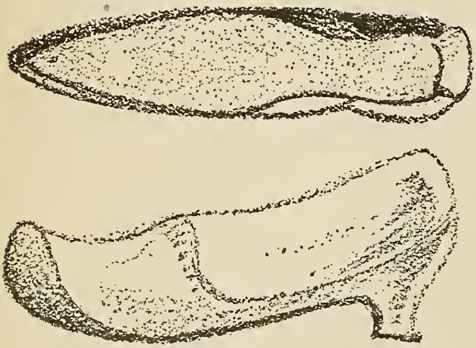
A Good Example of the 15th Century Period,
Pointed or Poulaine Shoe with Strap
for Tying It Over the Instep.



Examples of Broad Toed Leather Shoes of
Early 16th Century Date.



A Sole of a 15th Century Peaked Shoe.



A Pair of Crimson Morocco Leather Shoes,
Worn During Middle 18th Century.

A Broad Black Leather Toe Piece Pounced
and Slashed. It Measures 5½ inches Across.

CHART No 195

my return that all London is booted and apparently ready to walk out of town."

In this period, at the beginning of the Civil War, when England was divided in two great camps, Royalists and Republicans, the Royalists, or Cavaliers, were as much distinguished from the Republicans, or Roundheads, in their dress as in political principle. The dress of the Cavalier embodied all that savored of graceful ease and luxury. In place of the trunk hose, long breeches or short trousers, which were finished off with ribbons and fringe below the knee, were worn.

Nearly meeting these, came the boots with wide ruffles at the tops, which were often the cause of mishaps, as an unlucky gentleman remarks: "One of the rowels catched hold of the ruffle of my boot, and being Spanish leather, and subject to tear, overthrew me, rends me two pair of silk stockings, that I put on, being somewhat of a raw morning, a peach color and another."

This proves to us that ruffles were made of leather like the boot. It must have been much finer and softer to admit of being pulled and fringed out at the edge, as was commonly the case.

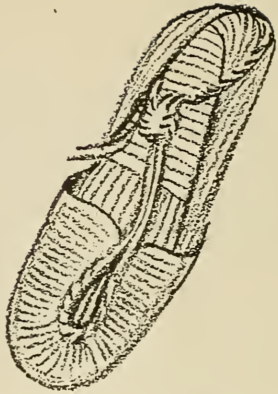
Indoors the Cavalier wore what was more becoming, viz., low shoes with rosettes, which showed the smart silk stockings to adtantage. Shoe tyes that go under the name of roses cost from thirty shillings to three, four and five pounds. Yea, a gallant of the line not long since paid thirty pounds for the pair.

The dress of the Puritans was very sombre, not because it was imposed on them, or because their rank and position made luxury unseemly, but from choice. To the Puritan all adornment was abhorrent, beauty a curse, and luxury a crime. The boots worn in the Cromwell era were principally made of Spanish buff leather. They were plain to ugliness, and were armed with a square piece of leather in front to keep the pressure of the stirrups from the instep.

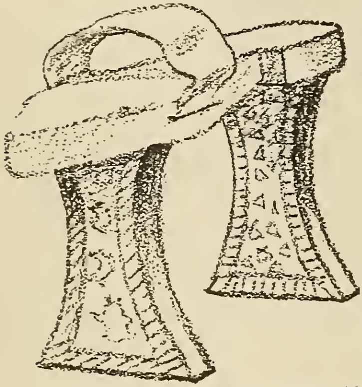
During the existence of the commonwealth, and for a long time after, the tops of the boots were of enormous width.

The shoes worn during the reign of Charles II. and James II. were distinguished by their high heels and long toes tapering towards

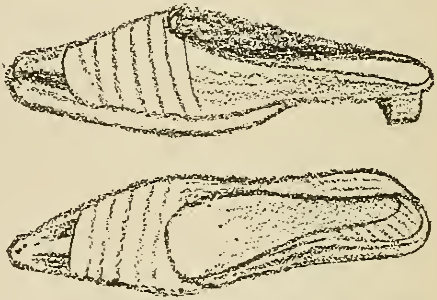
A Chinese Shoe for a Child.



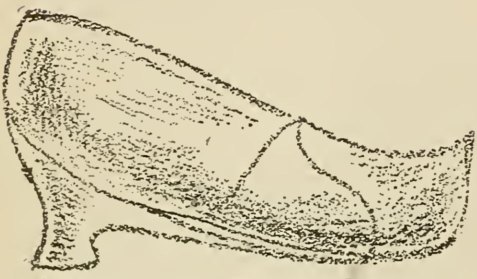
An Eastern Shoe Made of Hempen Strings.



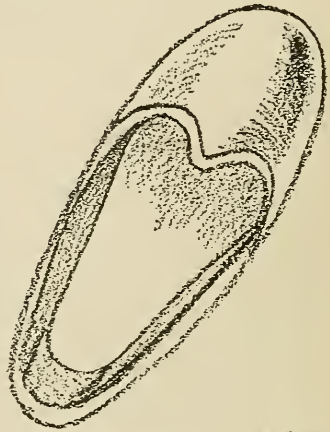
Wooden Chopine or Clog Worn by Turkish Women. This is 8 inches High.



An Eastern Pair of Wooden Soled Shoes.

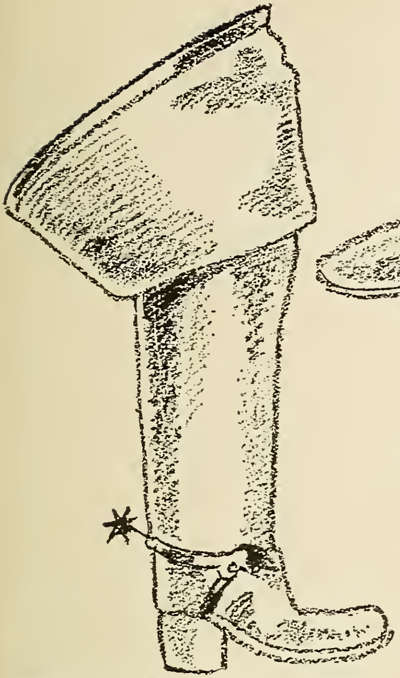


A Lady's Shoe of the Middle 18th Century.

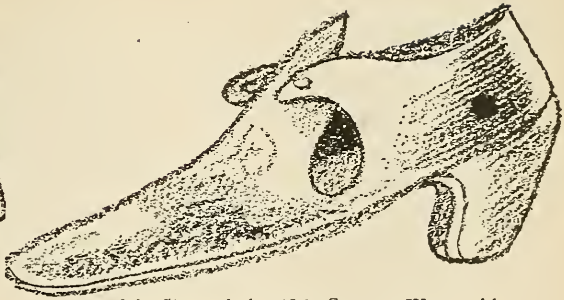


A Turkish Lady's Slipper Made of Green Leather.

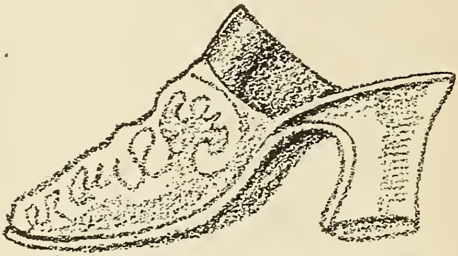
CHART NO. 196



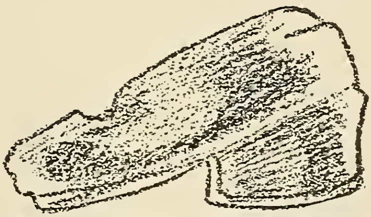
Jack-Boot Worn During the Cromwellian Period.



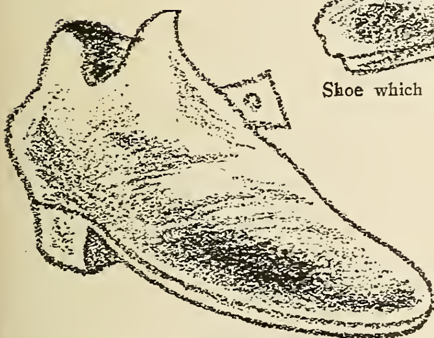
Lady's Shoe of the 18th Century Worn with a Clog.



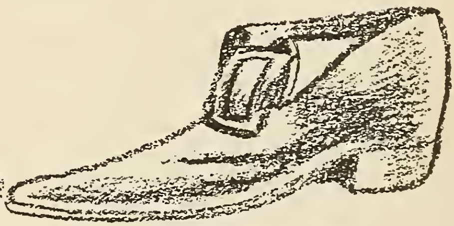
A 17th Century Lady's Shoe of Beautiful Workmanship, Made of Crimson Morocco Leather.



Shoe which Belonged to King Charles.



17th Century Leather Shoe.



An 18th Century Shoe.

CHART No. 197

the points, but cut square at the ends, the uppers of which not only covered the instep but extended far over the shins of the wearer.

Women of all degrees appear from the pictures we see to have indulged in high heeled shoes. Even a country lass, with her short skirt and basket on her arm, was perched up on heels which would not disgrace a fashionable bootmaker today.

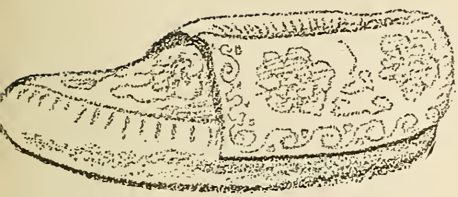
Sometimes the Puritan women wore the more sensible clog, or what was similar to that footgear, strapped across the foot, and keeping her well out of the mud. The citizeness of the richer class wore large rosettes on her shoes, and when she walked would hold up her gown over a lace-trimmed petticoat. Shoes of Spanish leather laced with gold were commonly worn, those worn by the men of fashion being squarer or less pointed toes with huge flaps ornamented with small buckles, the heels being somewhat higher and covered with colored leather.

It is said that buckles were first used in the reign of William III., but if this is true, how is it that the brass monument of Robert Attelath, at Lymm, who died in 1376, is depicted with shoes having buckles? It is fair to say that some are disposed to believe that the buckles worn prior to William III. were only used as ornaments.

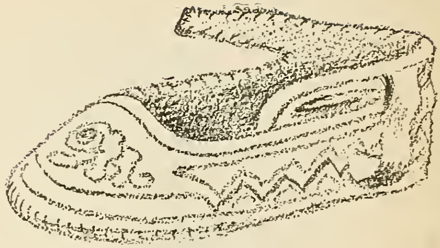
These buckles, worn so much at the time, were very costly, and it is beyond doubt, from the fact that they were often made from the most precious metals and studded with brilliants. William himself wore high jack boots, differing slightly in form from those of his predecessors, having the same instep guards and cut as ugly as can be imagined.

The shoes of the ladies had high heels, and it was quite common to bridge them with a leather clog.

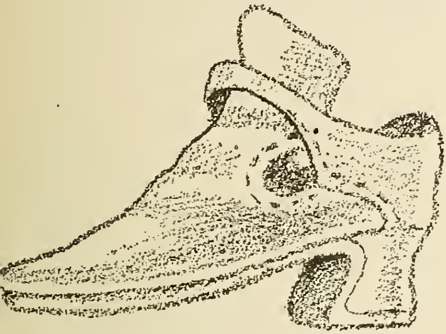
During the reign of George I. and II. the high-cut quarter shoe was continued to be worn by men, red being the fashionable color for the heels, and adorned with buckles of large dimensions. The shoes worn by the ladies were much handsomer than those worn by their immediate predecessors, the ugly square toes having been superseded by toes less broad and more sightly.



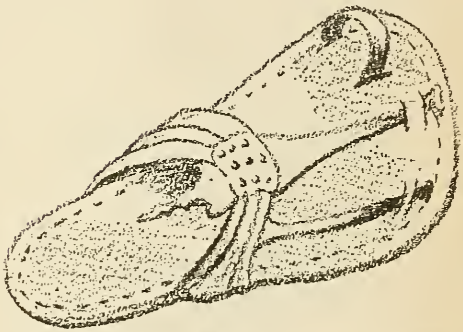
North American Moccasin.



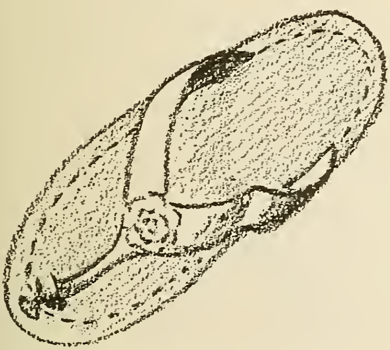
An Indian Child's Shoe.



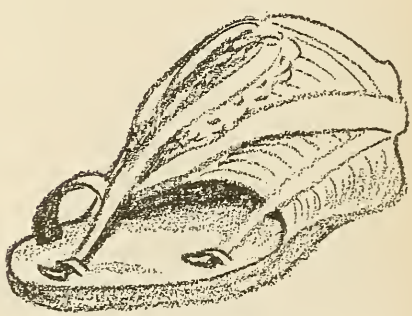
A Brown Leather Shoe with Double Latchets, Crossing Extremely High Instep Flaps and Fastening at the Sides by Means of a Button and Hook.



African Sandal of Niger River District. The Ringed Receptacle for the Great Toe is a Feature in the Sandal.

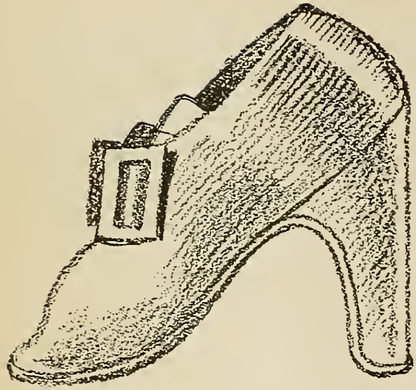


African Sandal of Plain Character.



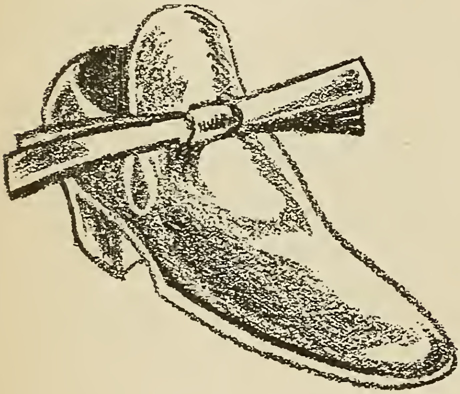
A Sandal from the Niger River District.

CHART No. 198

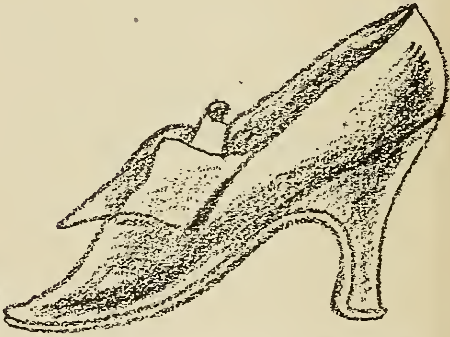


An 18th Century Gentleman's Shoe.

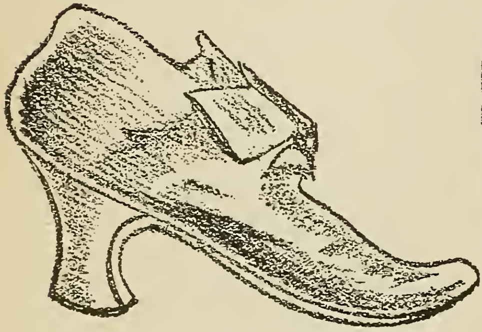
An 18th Century Lady's Clog.



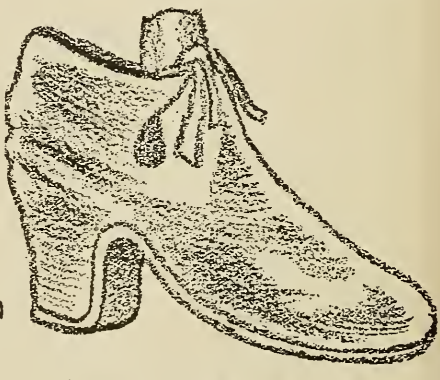
17th Century Shoe.



A Beautiful Shoe of the 18th Century Made of Crimson Velvet Embroidered with Gold.



17th Century Lady's Shoe.



A Common Every-Day Leather Shoe Worn During the 17th Century.

CHART No. 199

The clog worn was also improved by having the heel sunk to receive the heel of the shoe. The uppers were cut from silks and satins, and were richly embroidered. The heels of these shoes were made of wood, covered with silk, satin and fancy leather. With the advancement of time shoe quarters were cut lower and the heel brought more forward.

The short, varying shoes worn by the ladies came into vogue in the year 1790, and were of necessity low in the quarters, and they scarcely had any heel.

Shoes with buckles lasted to the commencement of the present period or, rather, revived at that time.

They were speedily succeeded by shoes fastened with strings. The buckle makers, being nearly ruined by this new mode in shoes, petitioned the then Prince of Wales to prohibit the wearing of shoestrings in favor of buckles, but his readiness to oblige the petitioners did not materially serve them.

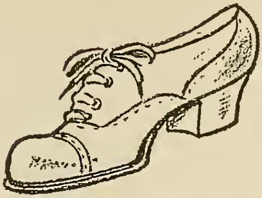
In the reign of George III. close fitting top-boots, the legs of which were cut from grained leather, were very commonly worn, the upper portion being cut to resemble the form of the leg, and it was finished with a turnover, or a top, as it was afterward called. Boots not so high were difficult to get on or off and in the process of time the height of leg was lowered. In many of these boots the turnover reached down to the ankle. It was during this reign that the Hessian came into fashion, conceded to be the handsomest boot ever worn.

This boot was a German importation, but boots cut similar to this were known to have been worn in Bohemia as early as 1700. This was followed by the Wellington.

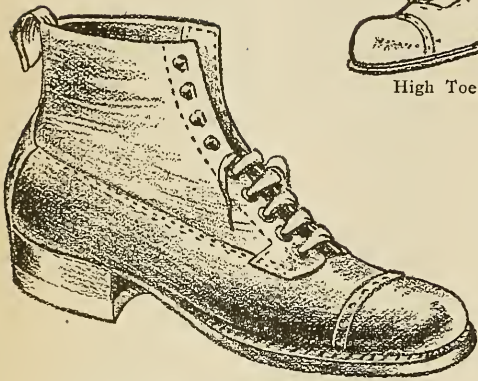
In the reign of George IV. the boots worn by the ladies were laced up the front. Side lacings revived in that of the succeeding monarch, and the "Adelaide" boot took its name from William's consort. Sandalled slippers were also worn and remained in fashion to the early portion of Queen Victoria's reign.

Ribbons for shoestrings were commonly employed at this period.

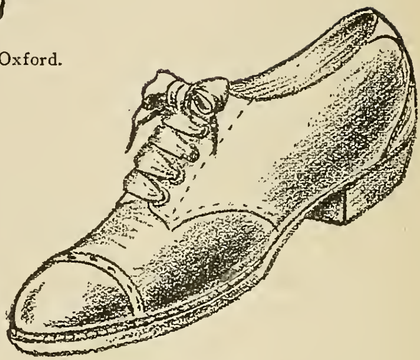
The cut of the quarters has since undergone many changes, military laced boots having become quite common for ladies' wear. There



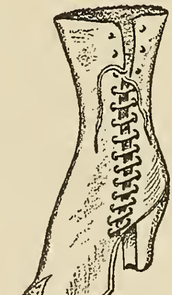
High Toe Oxford.



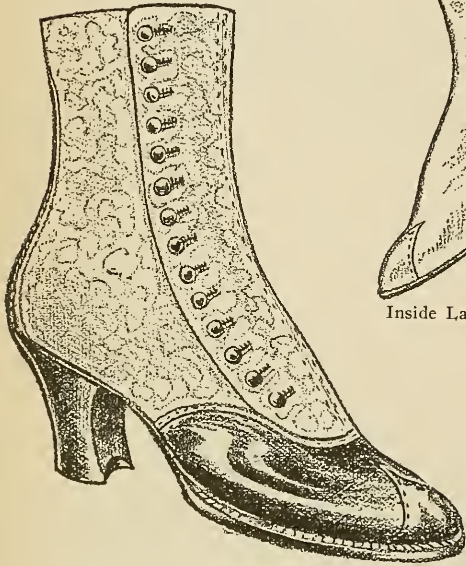
Walking Shoe with Rubber Heel.



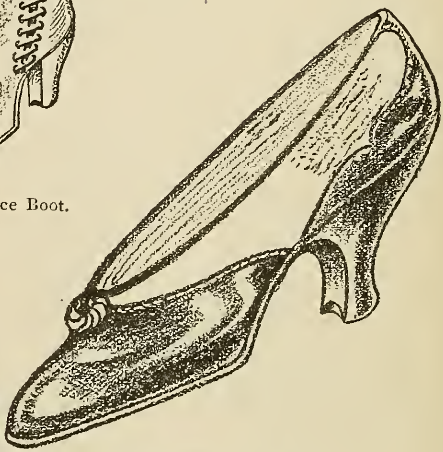
Blucher Oxford.



Inside Lace Boot.



Fancy Cloth Top Button Boot.



Patent Leather Dress Pump.

Chart No. 200

was an interval when the high heel was superseded by the low, soon after the high heel again asserted itself, and has remained popular to the present. Blucher shoes, which came into fashion in the early part of the Eighteenth century, continued in favor down to a very recent date, and are not yet entirely displaced. The modern shoes are now constructed on more hygienic lines, yet with a great variety of patterns, with variations in material. (See Chart No. 200.)

CHAPTER XL

FOOTWEAR AND FITTING OF SHOES

In the preceding chapter we have given a general history of shoes and footwear up to the present century, and if this general history is carefully read it will be seen why and how shoes are the principal cause of mechanical disturbances of the normal foot. It is shown that from the early ages considerable thought was given to style and fads rather than to the scientific requirements. This subject has been discussed in various publications, but the writers' opinions differ as to the fitting of the shoe, the construction of the last, and the size and height of the heel because, generally speaking, their deductions were based on the consideration of the perfectly normal foot.

My belief is that the feet of today—the feet that are fitted—are the ones to be considered, and these considerations should be governed by the size and shape of the foot, the style of the shoe desired by the shoe patron, the style and pattern of shoe the patron had previously worn, and the pliability and general condition of the foot.

In order to understand the subject thoroughly, it is first necessary to know of the general construction of the shoes of today, the measurements over which they are made, sizes, etc., which will be given in the following chapters.

Measurements of Last.—The foundation and principle in shoe making is founded on the measurements and the wood put into the last or form over which the shoe is made. All last makers tell us that the fixed standard of measurements and sizes are carefully followed out regardless of the style or shape of last to be constructed Thus, if this is true, the proportions while differing in shape are still of the same basic measurements. Now this would not necessarily mean that the shoe produced over a size 6E on one style of last would fit the same foot made in the same measurements with different shaping of the wood. For this reason the student should qualify by knowing the foot and last measurements, and study the conditions of the foot to be fitted.

The following are measurements adopted in the U. S. A. by the National Association of Retailers for standard shoe lasts:

Standard Shoe Last **MEN'S** **Measurements**

Sizes		6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	10 1/2	11	11 1/2	12
A	Ball	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8
	Waist ..	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 6/8	8 6/8	8 7/8	9	9 1/8
	Instep ..	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8
	Heel ...	11 4/8	11 5/8	11 6/8	11 7/8	12	12 1/8	12 2/8	12 3/8	12 4/8	12 5/8	12 6/8	12 7/8	13
B	Ball	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8
	Waist ..	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8
	Instep ..	8 4/8	8 6/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10
	Heel ...	11 6/8	11 7/8	12	12 1/8	12 2/8	12 3/8	12 4/8	12 5/8	12 6/8	12 7/8	13	13 1/8	13 2/8
C	Ball	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8
	Waist ..	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8
	Instep ..	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8	10 2/8
	Heel ...	12	12 1/8	12 2/8	12 3/8	12 4/8	12 5/8	12 6/8	12 7/8	13	13 1/8	13 2/8	13 3/8	13 4/8
D	Ball	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10
	Waist ..	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8
	Instep .	9	9 1/8	9 2/8	9 3/8	9 4/8	9 6/8	9 6/8	9 7/8	10	10 1/8	10 2/8	10 3/8	10 4/8
	Heel ...	12 2/8	12 3/8	12 4/8	12 5/8	12 6/8	12 7/8	13	13 1/8	13 2/8	13 3/8	13 4/8	13 5/8	13 6/8
E	Ball	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8	10 2/8
	Waist ..	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8
	Instep ..	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8	10 2/8	10 3/8	10 4/8	10 5/8	10 6/8
	Heel ...	12 4/8	12 5/8	12 6/8	12 7/8	13	13 1/8	13 2/8	13 3/8	13 4/8	13 5/8	13 6/8	13 7/8	14
F	Ball	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8	10 2/8	10 3/8	10 4/8
	Waist ..	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8	10 2/8	10 3/8
	Instep ..	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8	10 2/8	10 3/8	10 4/8	10 5/8	10 6/8	10 7/8	11
	Heel ...	12 6/8	12 7/8	13	13 1/8	13 2/8	13 3/8	13 4/8	13 5/8	13 6/8	13 7/8	14	14 1/8	14 2/8

Standard Shoe Last **LADIES'** **Measurements**

Sizes		2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7
A	Ball ...	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8
	Waist .	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8
	Instep .	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8
B	Ball ...	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8
	Waist .	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8
	Instep .	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8
C	Ball ...	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8
	Waist .	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8
	Instep .	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9

Standard Shoe Last **LADIES'—Continued** Measurements

Sizes		2½	3	3½	4	4½	5	5½	6	6½	7
D	Ball	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8
	Waist	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8
	Instep	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8
E	Ball	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9
	Waist	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8
	Instep	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8	9 4/8

Standard Shoe Last **MISSES'** Measurements

Sizes		11	11½	12	12½	13	13½	1	1½	2
A	Ball	5 6/8	5 7/8	6	6 1/8	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8
	Waist	5 5/8	5 6/8	5 7/8	6	6 1/8	6 2/8	6 3/8	6 4/8	6 5/8
	Instep	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8
B	Ball	6	6 1/8	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8	7
	Waist	5 7/8	6	6 1/8	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8
	Instep	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8
C	Ball	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8
	Waist	6 1/8	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8
	Instep	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8
D	Ball	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8
	Waist	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8
	Instep	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8
E	Ball	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8
	Waist	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8
	Instep	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8

Standard Shoe Last **BOYS'** Measurements

Sizes		1	1½	2	2½	3	3½	4	4½	5	5½
A	Ball	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8
	Waist	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8
	Instep	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8
	Heel	10	10 1/8	10 2/8	10 3/8	10 4/8	10 5/8	10 6/8	10 7/8	11	11 1/8
B	Ball	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8
	Waist	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8
	Instep	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8
	Heel	10 2/8	10 3/8	10 4/8	10 5/8	10 6/8	10 7/8	11	11 1/8	11 2/8	11 3/8

Standard Shoe Last — **BOYS'—Continued** — **Measurements**

	Sizes	1	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
C	Ball ..	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8
	Waist	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8	7 6/8	7 6/8	7 7/8	8
	Instep	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8
	Heel .	10 4/8	10 5/8	10 6/8	10 7/8	11	11 1/8	11 2/8	11 3/8	11 4/8	11 5/8
D	Ball ..	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8
	Waist	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8
	Instep .	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8
	Heel .	10 6/8	10 7/8	11	11 1/8	11 2/8	11 3/8	11 4/8	11 5/8	11 6/8	11 7/8
E	Ball ..	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8
	Waist	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8
	Instep .	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8
	Heel .	11	11 1/8	11 2/8	11 3/8	11 4/8	11 5/8	11 6/8	11 7/8	12	12 1/8
F	Ball ..	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8
	Waist	7 5/8	7 6/8	7 7/8	8	8 1/8	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8
	Instep	8 2/8	8 3/8	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8
	Heel .	11 2/8	11 3/8	11 4/8	11 5/8	11 6/8	11 7/8	12	12 1/8	12 2/8	12 3/8

Standard Shoe Last — **YOUTHS'** — **Measurements**

	Sizes	8	8 1/2	9	9 1/2	10	10 1/2	11	11 1/2	12	12 1/2	13	13 1/2
A	Ball	5 10/32	5 13/32	5 16/32	5 19/32	5 22/32	5 25/32	5 7/8	6	6 1/8	6 2/8	6 3/8	6 4/8
	Waist	5 6/32	5 9/32	5 12/32	5 15/32	5 18/32	5 21/32	5 6/8	5 7/8	6	6 1/8	6 2/8	6 3/8
	Instep	5 22/32	5 25/32	5 28/32	5 31/32	6 2/32	6 5/32	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8
	Heel	7 30/32	8 1/32	8 4/32	8 7/32	8 10/32	8 13/32	8 4/8	8 5/8	8 6/8	8 7/8	9	9 1/8
B	Ball	5 18/32	5 21/32	5 24/32	5 27/32	5 30/32	6 1/32	6 1/8	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8
	Waist	5 14/32	5 17/32	5 20/32	5 23/32	5 26/32	5 29/32	6	6 1/8	6 2/8	6 3/8	6 4/8	6 5/8
	Instep	5 30/32	6 1/32	6 4/32	6 7/32	6 10/32	6 13/32	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8
	Heel	8 6/32	8 9/32	8 12/32	8 15/32	8 18/32	8 21/32	8 6/8	8 7/8	9	9 1/8	9 2/8	9 3/8
C	Ball	5 26/32	5 29/32	6	6 3/32	6 6/32	6 9/32	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8	7
	Waist	5 22/32	5 25/32	5 28/32	5 31/32	6 2/32	6 5/32	6 2/8	6 3/8	6 4/8	6 5/8	6 6/8	6 7/8
	Instep	6 6/32	6 9/32	6 12/32	6 15/32	6 18/32	6 21/32	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8
	Heel	8 14/32	8 17/32	8 20/32	8 23/32	8 26/32	8 29/32	9	9 1/8	9 2/8	9 3/8	9 4/8	9 5/8
D	Ball	6 2/32	6 5/32	6 8/32	6 11/32	6 14/32	6 17/32	6 5/8	6 6/8	6 7/8	7	7 1/8	7 2/8
	Waist	5 30/32	6 1/32	6 4/32	6 7/32	6 10/32	6 13/32	6 4/8	6 5/8	6 6/8	6 7/8	7	7 1/8
	Instep	6 14/32	6 17/32	6 20/32	6 23/32	6 26/32	6 29/32	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8
	Heel	8 22/32	8 25/32	8 28/32	8 31/32	9 2/32	9 5/32	9 2/8	9 3/8	9 4/8	9 5/8	9 6/8	9 7/8
E	Ball	6 10/32	6 13/32	6 16/32	6 19/32	6 22/32	6 25/32	6 7/8	7	7 1/8	7 2/8	7 3/8	7 4/8
	Waist	6 6/32	6 9/32	6 12/32	6 15/32	6 18/32	6 21/32	6 6/8	6 7/8	7	7 1/8	7 2/8	7 3/8
	Instep	6 22/32	6 25/32	6 28/32	6 31/32	7 2/32	7 5/32	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8	7 7/8
	Heel	8 30/32	9 1/32	9 4/32	9 7/32	9 10/32	9 13/32	9 4/8	9 5/8	9 6/8	9 7/8	10	10 1/8
F	Ball	6 18/32	6 21/32	6 24/32	6 27/32	6 30/32	7 1/32	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8	7 6/8
	Waist	6 14/32	6 17/32	6 20/32	6 23/32	6 26/32	6 29/32	7	7 1/8	7 2/8	7 3/8	7 4/8	7 5/8
	Instep	6 30/32	7 1/32	7 4/32	7 7/32	7 10/32	7 13/32	7 4/8	7 5/8	7 6/8	7 7/8	8	8 1/8
	Heel	9 6/32	9 9/32	9 12/32	9 15/32	9 18/32	9 21/32	9 6/8	9 7/8	10	10 1/8	10 2/8	10 3/8

Standard Shoe Last **CHILD'S** Measurements

Sizes		6	$6\frac{1}{2}$	7	$7\frac{1}{2}$	8	$8\frac{1}{2}$	9	$9\frac{1}{2}$	10	$10\frac{1}{2}$
A	Ball	$4\frac{28}{32}$	$4\frac{31}{32}$	$5\frac{2}{32}$	$5\frac{5}{32}$	$5\frac{8}{32}$	$5\frac{11}{32}$	$5\frac{14}{32}$	$5\frac{17}{32}$	$5\frac{20}{32}$	$5\frac{23}{32}$
	Waist ..	$4\frac{26}{32}$	$4\frac{29}{32}$	5	$5\frac{3}{32}$	$5\frac{6}{32}$	$5\frac{9}{32}$	$5\frac{12}{32}$	$5\frac{15}{32}$	$5\frac{18}{32}$	$5\frac{21}{32}$
	Instep ..	$5\frac{8}{32}$	$5\frac{11}{32}$	$5\frac{14}{32}$	$5\frac{17}{32}$	$5\frac{20}{32}$	$5\frac{23}{32}$	$5\frac{26}{32}$	$5\frac{29}{32}$	6	$6\frac{3}{32}$
B	Ball	$5\frac{4}{32}$	$5\frac{7}{32}$	$5\frac{10}{32}$	$5\frac{13}{32}$	$5\frac{16}{32}$	$5\frac{19}{32}$	$5\frac{22}{32}$	$5\frac{25}{32}$	$5\frac{28}{32}$	$5\frac{31}{32}$
	Waist ..	$5\frac{2}{32}$	$5\frac{5}{32}$	$5\frac{8}{32}$	$5\frac{11}{32}$	$5\frac{14}{32}$	$5\frac{17}{32}$	$5\frac{20}{32}$	$5\frac{23}{32}$	$5\frac{26}{32}$	$5\frac{29}{32}$
	Instep ..	$5\frac{16}{32}$	$5\frac{19}{32}$	$5\frac{22}{32}$	$5\frac{25}{32}$	$5\frac{28}{32}$	$5\frac{31}{32}$	$6\frac{2}{32}$	$6\frac{5}{32}$	$6\frac{8}{32}$	$6\frac{11}{32}$
C	Ball	$5\frac{12}{32}$	$5\frac{15}{32}$	$5\frac{18}{32}$	$5\frac{21}{32}$	$5\frac{24}{32}$	$5\frac{27}{32}$	$5\frac{30}{32}$	$6\frac{1}{32}$	$6\frac{4}{32}$	$6\frac{7}{32}$
	Waist ..	$5\frac{10}{32}$	$5\frac{13}{32}$	$5\frac{16}{32}$	$5\frac{19}{32}$	$5\frac{22}{32}$	$5\frac{25}{32}$	$5\frac{28}{32}$	$5\frac{31}{32}$	$6\frac{2}{32}$	$6\frac{5}{32}$
	Instep ..	$5\frac{24}{32}$	$5\frac{27}{32}$	$5\frac{30}{32}$	$6\frac{1}{32}$	$6\frac{4}{32}$	$6\frac{7}{32}$	$6\frac{10}{32}$	$6\frac{13}{32}$	$6\frac{16}{32}$	$6\frac{19}{32}$
D	Ball	$5\frac{20}{32}$	$5\frac{23}{32}$	$5\frac{26}{32}$	$5\frac{29}{32}$	6	$6\frac{3}{32}$	$6\frac{6}{32}$	$6\frac{9}{32}$	$6\frac{12}{32}$	$6\frac{15}{32}$
	Waist ..	$5\frac{18}{32}$	$5\frac{21}{32}$	$5\frac{24}{32}$	$5\frac{27}{32}$	$5\frac{30}{32}$	$6\frac{1}{32}$	$6\frac{4}{32}$	$6\frac{7}{32}$	$6\frac{10}{32}$	$6\frac{13}{32}$
	Instep ..	6	$6\frac{3}{32}$	$6\frac{6}{32}$	$6\frac{9}{32}$	$6\frac{12}{32}$	$6\frac{15}{32}$	$6\frac{18}{32}$	$6\frac{21}{32}$	$6\frac{24}{32}$	$6\frac{27}{32}$
E	Ball	$5\frac{28}{32}$	$5\frac{31}{32}$	$6\frac{2}{32}$	$6\frac{5}{32}$	$6\frac{8}{32}$	$6\frac{11}{32}$	$6\frac{14}{32}$	$6\frac{17}{32}$	$6\frac{20}{32}$	$6\frac{23}{32}$
	Waist ..	$5\frac{26}{32}$	$5\frac{29}{32}$	6	$6\frac{3}{32}$	$6\frac{6}{32}$	$6\frac{9}{32}$	$6\frac{12}{32}$	$6\frac{15}{32}$	$6\frac{18}{32}$	$6\frac{21}{32}$
	Instep ..	$6\frac{8}{32}$	$6\frac{11}{32}$	$6\frac{14}{32}$	$6\frac{17}{32}$	$6\frac{20}{32}$	$6\frac{23}{32}$	$6\frac{26}{32}$	$6\frac{29}{32}$	7	$7\frac{3}{32}$

These sizes are divided, for the convenience of the student interested in shoe fitting, into the following classes. They show also the measurements and lengths of the various sizes by inches.

Infants' Sizes 0 to 5

Size 0 measures in length 4 inches.
Size 1 measures in length 4⅓ inches.
Size 2 measures in length 4⅔ inches.
Size 3 measures in length 5 inches.
Size 4 measures in length 5⅓ inches.
Size 5 measures in length 5⅔ inches.

Children's Sizes Run from Sizes 6 to 8

Size 6 measures in length 6 inches.
Size 7 measures in length 6⅓ inches.
Size 8 measures in length 6⅔ inches.

Children's Sizes, Second Run, 9 to 11

Size 9 measures in length 7 inches.
Size 10 measures in length 7⅓ inches.
Size 11 measures in length 7⅔ inches.

Youths' and Misses' Sizes, 12 to 2

Size 12	measures in length	8 inches.
Size 13	measures in length	8⅓ inches.
Size 1	measures in length	8⅔ inches.
Size 2	measures in length	9 inches.

Boys' Sizes, 2½ to 5

Size 2½	measures in length	9½ inches.
Size 3	measures in length	9⅓ inches.
Size 4	measures in length	9⅔ inches.
Size 5	measures in length	10 inches.

Women's Sizes 2 to 8

Size 2	measures in length	9 inches.
Size 3	measures in length	9⅓ inches.
Size 4	measures in length	9⅔ inches.
Size 5	measures in length	10 inches.
Size 6	measures in length	10⅓ inches.
Size 7	measures in length	10⅔ inches.
Size 8	measures in length	11 inches.

Men's Sizes 6 to 12

Size 6	measures in length	10⅓ inches.
Size 7	measures in length	10⅔ inches.
Size 8	measures in length	11 inches.
Size 9	measures in length	11⅓ inches.
Size 10	measures in length	11⅔ inches.
Size 11	measures in length	12 inches.
Size 12	measures in length	12⅓ inches.

The above measurements in length are the measurements at the ball, waist and heel. These are the principal measurements to be considered.

METHOD OF MEASURING THE FOOT FOR FITTING READY-TO-WEAR SHOES

The equipment for shoe fitters is, first, the standard measurement stick, a rule showing the measurements in inches and the measure-

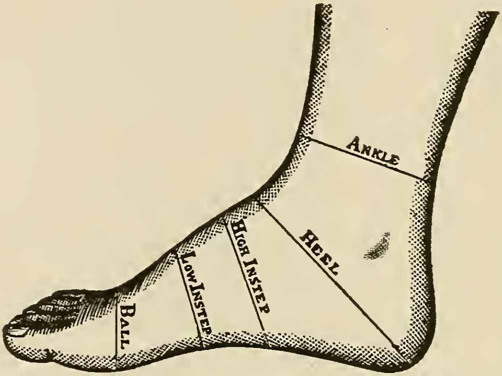


Chart No. 201
Illustrating Measurements and Manner of Taking Measurements.

ments of shoes in sizes given on the top surface of the rule. As an adjunct a shoemaker's measuring tape should be used. (See Charts Nos. 202 and 203.)

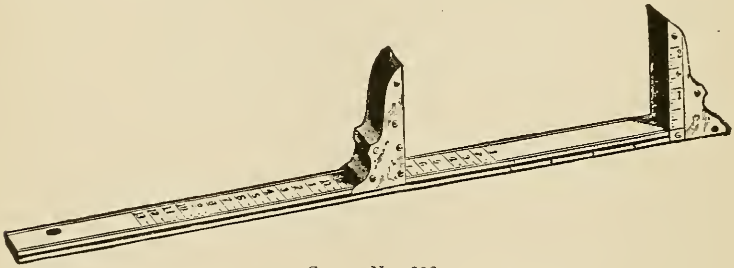


Chart No. 202
Standard Measurement Stick for Shoe Fitters.

The present method of shoe fitting and measurements is based principally on the length, and the fitting of the shoe in width is left to the discretion and good judgment of the fitter. The shoe dealer or shoe fitter who has had sufficient experience can usually recognize the width of shoe by the appearance of the foot, with the help of the measurement of the length of foot on the measuring stick.

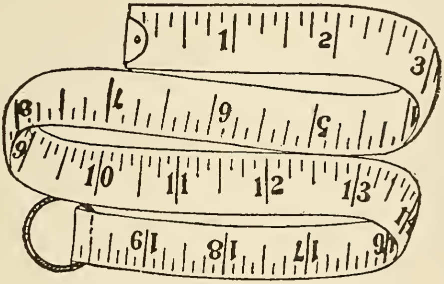


Chart No. 203
Shoemaker's Measuring Tape

The measuring of the length in fitting shoes is very important, because more malformations and deformities are caused by shoes fitted too short, than by those fitted too narrow or too wide.

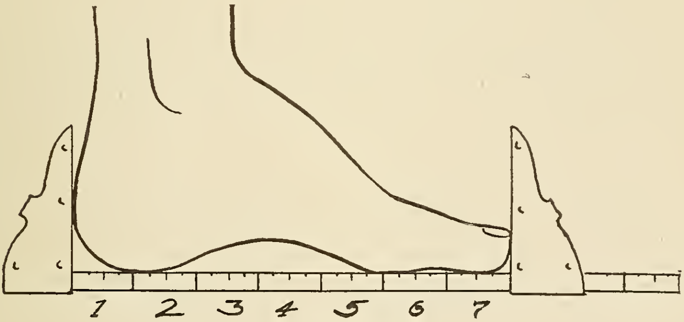


Chart No. 204
Foot Being Measured without Weight on.

The foot is placed on the measuring stick and the weight of the body borne on it. The reason for this is to allow for the natural expansion of the normal foot and the elongation of the abnormal, weakened or flat-foot, so as to still allow sufficient length to the foot in the standing upright position.

Practically all feet expand slightly when the weight of the body is placed upon them. The natural expansion should not be over one-sixteenth to one-quarter inch. If there is more elongation present it is due to weakness of the Longitudinal arch, allowing the foot to spread and elongate.

When the foot is measured with the weight upon it, an allowance of one and one-half to two and one-half sizes for proper length should be made. In other words, the length of shoe selected should measure that much longer than the entire length of the foot in a standing position.

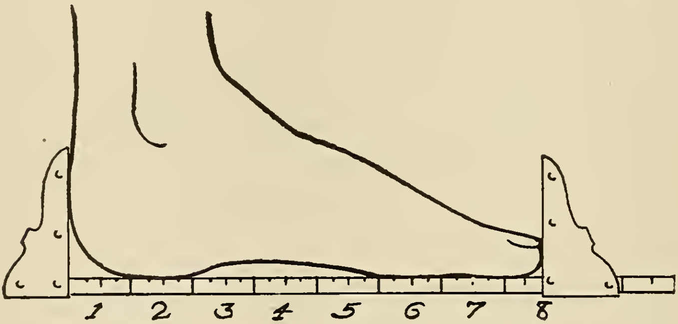


CHART No. 205
Same Foot Measured with Weight on, Showing Elongation of One Full Size.

Any disturbances of the foot, such as deformed toes, ingrowing toe-nails, weakened transverse arch, weakened longitudinal arch, broken-up arch, can be traced directly to the wearing of short shoes. Bunions, enlarged joints, crooked toes, can also be traced to short shoes.

Now, as regards to what constitutes a good fit, the following rules should be carefully carried out: First, the correct length, one and one-half to two and one-half sizes longer than the actual measurement of the foot; second, width, sufficient width at the ball to allow for the natural spread of the foot at that point without compressing the foot; third, a snug fit through the heel and instep; fourth, if a lace shoe, the top stay should not come close together, but expanding enough to permit of enough space to enable one to draw the top or instep of the shoe snug without meeting. Care should be taken in the selection of a shoe so as to allow a sufficient space over the toe cap or seams to prevent restriction to foot action. The style of heel must depend upon the customer or patient, and the style of heel previously worn must be taken into consideration. Women who have habitually walked on high heels should be permitted to continue to wear them unless the change is made by very small degrees.

If a foot poised for a high heel is put into a low heel shoe, you disturb the balancing of the whole body, to say nothing of what it will do to the foot; but remember that a great many disturbances, nervousness and other conditions result. The poise of the foot accustoms itself, and the ligamentous and muscular attachments are likewise adjusted to that poise.

In the fitting of shoes, and in the correction of foot troubles, it is necessary to take into consideration the fact that nearly everyone has deformed feet as a result of improper shoes since childhood, and after they have reached an age in life where development is completed it is quite difficult to make any alterations in the skeleton of the foot. This is a very broad and useful rule and understanding to have in shoe fitting, and in the selection of footgear for corrective purposes.

The flat heeled, broad toed type of shoe, and the extreme patterns of corrective shoes following the theory of Meyer in drawing a straight line through the center of the heel to the center of the great toe, cannot be thoroughly depended upon as good fitters for reasons previously stated. Therefore, shoes should be constructed over lasts designed on anatomical principles constituting a perfectly normal foot. And while, in so doing, one is carried a considerable distance from the present day type, that construction will permit nature to assert herself. Shoes having a straight or nearly straight inside line are preferable.

There is probably no factor so important in the causation of foot weakness and disturbances as that of the shoe. Shoe fitters and shoe salesmen and clerks in retail stores should be posted on the mechanical construction of the foot, which has been thoroughly discussed in the preceding chapter. They must understand that there are various types of feet, those having high arches, low arches, the long, slender foot, the short, wide foot, and the feet that are abnormally thick and abnormally thin, in large and small sizes. Then, one must know the elastic movements of the foot, and what is required in different ages and in different occupations and climates, and it has been

Chart No. 206
Showing Meyer's Line.

proved time and again that the requirements of the foot are different at different ages. In infancy the foot is broad at the toes and narrow at the heel, and the bones are soft and tender. It is at this period that the foot is growing rapidly, and like all other organized bodies under similar circumstances, the feet are very easily distorted and injured by external pressure. Therefore, at this age great care must be taken so that the child arrives at maturity free from deformity caused by ill-fitting shoes. I am glad to notice that within the past ten years wonderful strides in the manufacture of children's shoes have been made, and instead of crowding the foot into a pointed toe shoe it is now allowed to glide into the orthopedic shape shoe, leaving room for the five toes.

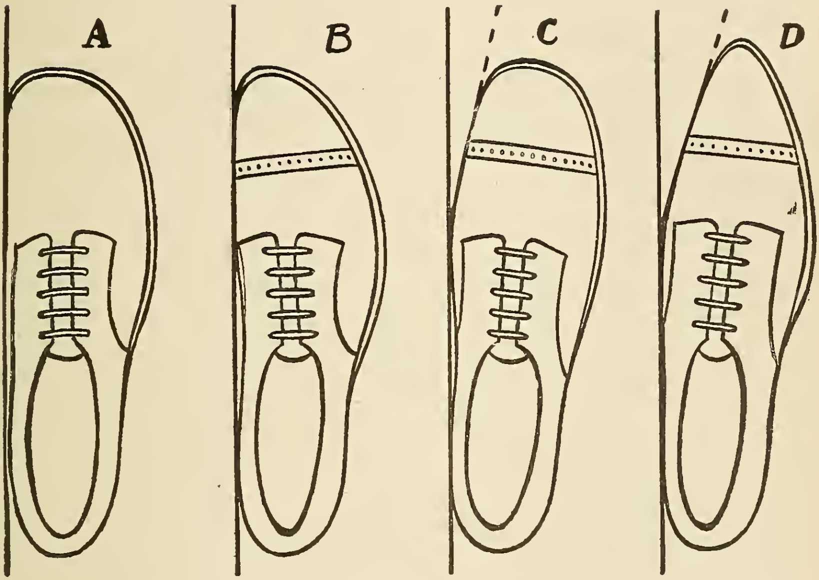


CHART No. 207

A—Straight Inside Line Shoe with Broad Toe.
B—Straight Inside Line Shoe with Modified Toe.
C—Broad Toe with Swing to Outside, Away from Straight Inside Line.
D—Narrow Toe with Swing to Outside, Away from Straight Inside Line.

Between the ages of nine and fourteen extreme care must be taken in fitting children's feet, because there is considerable expansion and growth at this period, and but very little thought or care is given to the feet by themselves. From the age of fourteen to twenty-one years the foot gradually assumes a more mature form, the Tarsus becoming thicker, but during this age young people are more apt to

CHART No. 208
Foot Thick Through Heel and Ankle, with Enlarged Great Toe Joint.

CHART No. 209
Foot with Low Instep at Waist, Otherwise Normal.

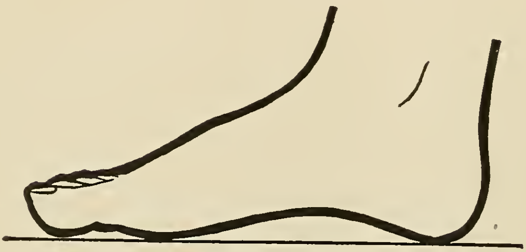


CHART No. 210
Foot Showing Normal Arch.

have notions of fashion and style, and cramp their feet into narrow toed and short shoes.

There is much to be said also in the application of the shoe fitting knowledge to persons of old age. The foot having attained its maturity is still, however, subject to changes peculiar to organic life, such as the daily waste repairs, and wear and tear from exercise, consequently provision must be made allowing free action in these respects. It is in older age that muscular weakness, such as weakened foot and flat-foot, develops.

Then again provision must be made for the corpulent men and women, where there is rigidity of the structure of the feet and limbs, and a further provision must be made for occupations requiring persons to be long hours on their feet.

If feet are fitted properly, and no structural weakness exists, there should be no more discomfort to the feet than to the hands, independent of the fact that the body's weight is carried constantly on them. It must be stated that the mechanical construction of the human body is such that due allowance has been made for the work imposed upon its members.

SUMMARY

The shoe fitter, then, should possess the necessary qualifications, and following knowledge:

First. Knowledge of the structure of the human foot, bones, muscles, ligaments and tendons.

Second. Be able to recognize abnormal from normal feet.

Third. Be able to detect the variations in feet, and intelligently assist in fitting the normal foot to preserve its normal condition.

Fourth. Abnormal feet should be carefully examined and inquiry made as to the cause, and the right method of fitting or correcting the cause ascertained.

Fifth. To know from symptoms, such as callosities, corns, soft corns, bunions, etc., that these may be produced by slight bone displacements, and to have the correct shoes and appliances to relieve the underlying cause, with an object in view of correcting the abnormality.

Sixth. To be able to detect the weak, flexible foot that requires mechanical aid, and a knowledge of fitting and adjusting appliances to give relief.

Seventh. To have a knowledge of shoe making, of modern shoe construction, and be able to judge the fitting qualities of shoes, whether they are extreme fashions or modified orthopedic shoes, and apply the right shoe on the right foot.

Eighth. To be able to recognize abnormal conditions from symptoms easily traced by the manner in which the old shoes have been worn.

All men and women do not walk in the same manner. They do not throw or roll about their shoes in the same manner. This may be caused by physical defects, weakness in the muscular control, false positioning of the structures, and also due to occupations in the varied walks of life. Old men and women walk considerably different, due to the general declining condition of the tissues. Tall persons walk with a different stride than the short, stout people. Old people who walk with their heads bowed are obliged to bend the knees to preserve their equilibrium. Women who have always worn high heel shoes and have then changed to low heels are obliged to change their gait to maintain their equilibrium. Women, towards the end of pregnancy, walk with the upper part of their frame thrown upward to maintain their equilibrium, which changes their gait in walking. Persons whose shoes are short make indentations in the inner cap of the toe of the shoe, and the end of the toe of the sole is usually stubbed off. Persons with severe, irritating corns throw their weight on the heel so as to avoid pressure. Persons with bunions, enlarged toe joints, which may be caused by weak arch or flat-foot, wear their shoes to the outside in an endeavor to avoid pressure. Those with weak ankle and flat-foot wear off the inner border of the heels, owing to the overbalancing of the weight on the inner border of the arch.

Persons having Metatarsalgia or weakened foot in the anterior arch spread the uppers of the shoe across the ball of the foot from the outside edge of the sole, and will frankly admit that no shoe seems to hold its shape.

Women having arch weakness complain of slippers and low shoes bulging on the sides, and are not successful in securing a neat fit. Slipping at the heel is also frequently due to a weakness of the arch.

CHAPTER XLI

HOSIERY

This is a very important subject to the practitioner of mechanical orthopedics, inasmuch as socks and stockings have a vast influence in causing disturbances of the foot. Indeed, it is not uncommon to know or to notice cases of foot distortions due primarily to pointed toe and short, unyielding stockings.

Fig. A

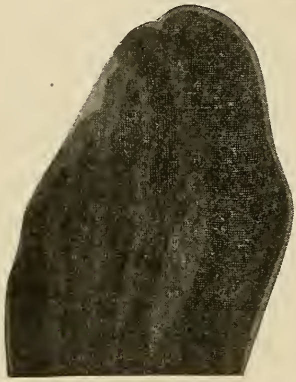


Fig. B

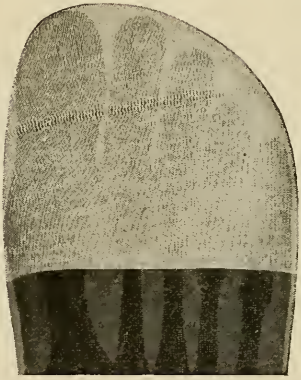


Chart No. 211

X-Ray Showing Foot in Pointed Toe Hose and in Toe Free Hose.

A, X-Ray Showing How Ordinary Stocking Crowds the Toes.

B, X-Ray Showing the Same Foot in Toe Free Stocking.

You have all experienced at some time or other the agony of being required to thrust your foot into a stocking possibly of wool or other material which had been badly shrunken, and how uncomfortable and annoying they were to the feet until by actual pressure and expansion created by the foot that yielding of the yarn was made possible. I have frequently noticed this in my practice where mothers are compelled to stretch and pull the stocking in order to be able to draw it over the infant's chubby foot and leg.

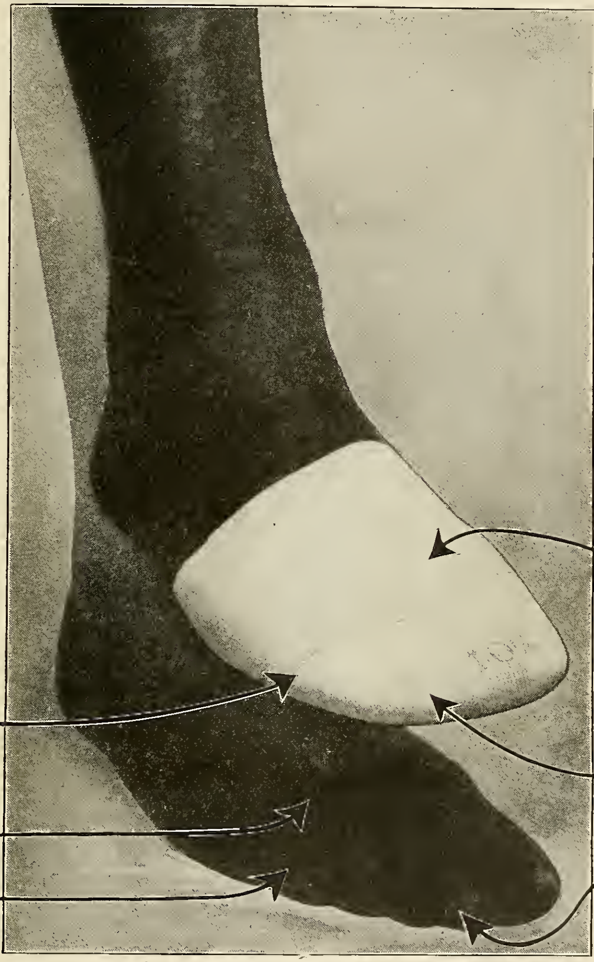


CHART No. 212
Showing Correct and Incorrect Hose.

Great care should be taken from the first wearing of socks or stockings, beginning with the child. For children, the stockings in summer should be made of fine white cotton or silk, or silk and wool; then in winter or cold weather they may be made of a light woolen fabric, knit flexible enough to cling to the foot but not disturb the natural little motions.

Extreme care must be taken in having the stocking sufficiently long and wide at the toes. It is true in the infant that as much action is given to the toes as to the fingers, and these little motions which mean much in the development of the muscles of the lower limbs

Chart No. 213
Digitated Hose.

should not be interfered with. In adults the result of the early wearing of short, pointed toe hosiery may be found in such distortions as hammer toes, bunions and flat-foot. In practically all cases of structural weakness it will be found upon careful investigation that stockings have contributed their destructive work through interfering with the natural motions of the foot.

Not uncommonly will you find a patient well fitted in two shoes, but the foot actions restricted by the pointed toe short hose. Among women this is very common where the combination hose supporters are worn, as the action of walking and body motion has a tendency to draw the stocking tight around the foot and toes, and among most women and children the action of walking and stepping has a tendency of drawing the stocking tight about the foot as one would work the fingers of a glove over the hand.

CHART No. 214
Hose with Compartment for Great Toe.

Again, the modern way of knitting hosiery to a point requires the foot to labor considerably before space for the five toes has been located.

In the mechanical treatment of hallux valgus, hammer toes and contracted toes, where mechanical treatment has been resorted to, extreme care must be observed in giving advice to the patient as to hosiery.

Chart No. 213 represents a digitated hose, affording a separate compartment for each toe, constructed along the same line as the glove having separate fingers for the hand. This permits complete mobility and action to the toes and the muscular attachments, but is not so practical for general purposes, as an extremely wide shoe is required to permit of the additional space necessary due to the double layers of materials between the toes. The digitated toe stockings are indicated, however, in many deformities of the toes.

Chart No. 214 shows a very practical stocking, which is constructed to have a compartment for the great toe only. When made of the right material and correct shape, permitting space for the remaining four toes without hampering, this style of stocking can be made practical use of in bunions or dislocation of the first phalanx of the great toe and is especially indicated. It is also very useful where bunion right or toe flex devices are worn to support the great toe and hold it to its natural position.

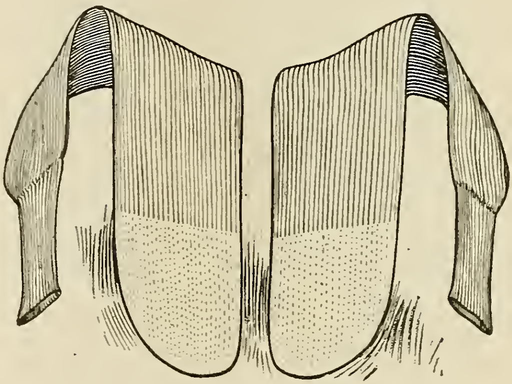


Chart No. 215
A Right and Left Style of Hosiery.

Chart No. 215 represents the right and left style of stockings, which are very practical from the orthopedic standpoint, but are rather difficult for the person wearing them unless they are continuously worn on the same feet.

Chart No. 216 represents the most practical and ingeniously designed stocking, which can be worn with a greater degree of comfort, and have the greatest prophylactic value in preserving the natural movement of the foot. It is knitted over a model or frame, which permits its being worn on either right or left foot, and being quite nearly square with only sufficient tapering to overcome any extreme fullness, permitting the natural toe movements. This style of stock-

Chart No. 216
Toe-Free Hose.

ing has been used by the author in his many years of practice with success, and is known as the toe-free hose. I am sure the orthopedic practitioner will appreciate the many advantages and the wide range of usefulness that this hosiery will command.

In the X-ray plates (Chart No. 211) Fig. A indicates the ordinary stocking or sock with distorted phalanx while Fig. B shows an X-ray of the toe-free pattern, indicating perfect freedom of the Phalanges.

Summary.

The stocking, to assist in foot treatment, should then consist of:

First. One made of a smooth weave, free from wrinkles, seams, etc.

Second. If feet are tender, toe part or foot of stocking should be made of a soft undyed yarn.

Third. Never allow fancy dyed hosiery to be worn by persons having any skin abrasions, blisters, excessive perspiration or tenderness.

Fourth. The size of the stocking should be selected according to measurement. In men's sizes they range from 9½ to size 12. The usual size markings indicate inches, and one-half inch should be added to the measurement of the foot.

Fifth. When the stocking is on the foot there should be no sensation of pressure about the toes, and the length from heel to toe should be sufficient to permit the natural expansion of the foot when the weight is placed upon it.

Sixth. Don't have the stocking too large or too long. Wrinkles will form and blisters may result.

Seventh. The stockings must be kept absolutely clean. They should be thoroughly washed with warm water and soap, thoroughly rinsed and dried in the sun. A clean pair should be worn each day. Where stockings are not washed each day they should be worn alternately.

Eighth. Dusting the inside of the stocking with an antiseptic foot powder will reduce friction and act as a disinfectant, and has a corrective action on the skin.

CHAPTER XLII

CARE OF THE FEET

As considerable comfort and pleasure depend on keeping the feet in a state of health, I will discuss in this chapter the care and attention feet require. From the time shoes and stockings are first worn care and attention is essential. The feet should be washed thoroughly with a good antiseptic soap, the granular form being the most beneficial; they should then be wiped and thoroughly dried, particularly between the toes. The nails should be cut square, and not often, care being taken that they are not cut below the top of the toes, as they are likely to result in onychia (ingrowing toe-nail).

In addition to washing, the feet should be bathed, this being necessary in various conditions of the feet. The proper and most convenient time is at night just before retiring, but under peculiar circumstances they may require bathing at other times during the day.

The use of hot or cold water for bathing the feet depends greatly on the difference, and constitution, and habits; thus, for persons advanced in years the tepid bath is preferable, especially if they are subject to gout or rheumatism. A change of temperature in such cases may cause serious results, and this treatment is to be deferred while the patient is suffering from either of those disorders. As a rule, it is not advisable for old people to bathe the feet; however, great comfort may be derived from sponging them once or twice a week, using a granular antiseptic soap and warm water, which will soften the scales and cuticle, and can subsequently be rubbed off with a coarse towel.

When the feet become fatigued and inflamed after a day's use, they should be bathed in a hot antiseptic solution for about fifteen or twenty minutes. As soon as the feet have been dried, the callosities and excrescences can be rubbed off with a coarse towel. Then the feet should be thoroughly massaged, using the healing, penetrating pedico foot balm. If the skin is naturally soft and moist, an astringent solution should be used. When the skin on the Plantar surface is hard and chapped, it must be rubbed until it becomes smooth, after which the foot is massaged with soothing balm. If the fissures extend through the skin after the thickening has been removed, their sides should be kept in apposition with strips of adhesive plaster drawn tightly over the Dorsal side.

The perspiration of the feet rarely if ever requires medical attention, unless it is so excessive as to be a source of annoyance, or the odor so disagreeable as to be offensive. The latter causes the person affected much discomfort. The odor in warm weather or hot rooms is most perceptible, and in many cases so fetid that the society of the person affected is avoided.

There is not any permanent cure, but bathing the feet in antiseptic and astringent solutions, with frequent change of stockings in which a good foot powder has been previously sprinkled, usually ameliorates the condition.

Feet that are cold and clammy denote debility, and only temporary relief can be expected from external applications.

The feet, like the face, hands and hair, should be carefully attended to each day as a matter of comfort and refinement. They should be washed well with pedico granular soap, massaged with pedico foot balm and then antiseptic powder should be sprinkled over the feet and in the stockings. Change stockings each day and alternate the wear of shoes.

CHAPTER XLIII

METHOD OF MAKING PLASTER OF PARIS CAST OF THE FOOT

The making of a good plaster of paris model of the foot is not a difficult operation, and can be readily learned with a little practice and adherence to the following directions. As the quantity of plaster

CHART No. 217
After Foot Has Been Lubricated It is Placed in Plaster.

required to make the mixture depends on atmospheric conditions and grades of plaster used, we have selected for convenience the standard plaster known as "New York Dental Grade," and which requires about four pounds to a quart of water.

In preparing the plaster for making the cast, it should be gradually added to the water, stirring it with the hands or a spoon until thoroughly mixed to the consistency of a heavy cream.

When taking a Plantar or sole impression of the foot, procure a shallow box, or lid of a shoe carton, large enough to permit the entrance of the entire foot; previously lined with a towel covered with tissue paper, which is to hold the plaster of paris.

In order to prevent the adherence of plaster to the flesh, cold cream or vaseline should be applied to that part from which the cast

Chart No. 218
Heaping Plaster Under the Arch.

is to be made. If the patient has a heavy growth of hair, it is advisable to shave that portion coming in contact with the cast.

Now that all is in readiness, prepare the plaster as described above and pour it into the box, heaping it up well under the arch, being careful that it is of the proper consistency; otherwise it will flow over the edge of the container.

The patient should then be seated in a comfortable position, with his foot resting in the plaster as in Chart No. 217, exerting sufficient pressure to take an impression of the heel and toes. When the foot is firmly settled, grasp the towel and paper as in Chart No. 218, and draw the plaster up towards the instep on the inner side of the foot.

CHART No. 219
Grasping Towel Containing the Plaster and Heaping It Against Arch.

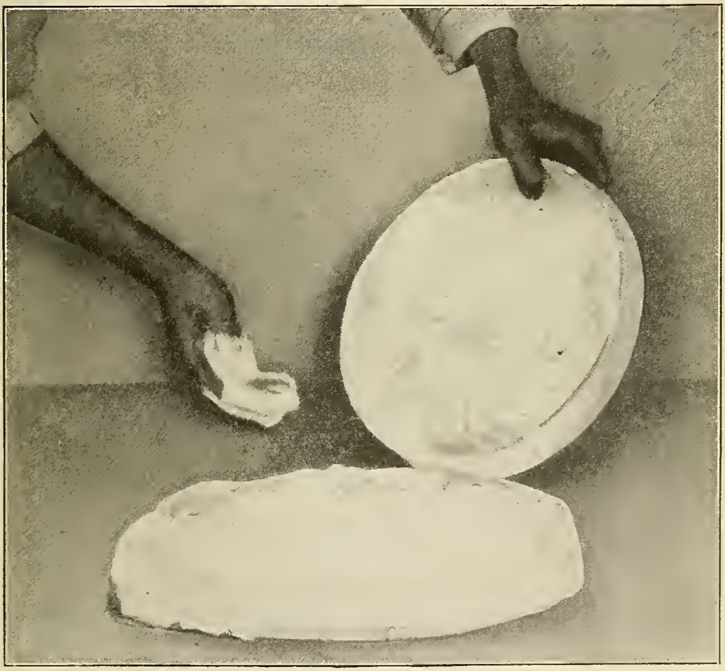


CHART No. 220
After Cast of Sole Surface is Lubricated, Plaster Mixture is Poured Into It.

Chart No. 219 gives you another view of the same operation, showing the other foot. This is the method to follow for taking Plantar or sole impressions.

Chart No. 221
Breaking Plaster Cast Away from Positive or Counter Cast.

Chart No. 222
Cast Freed from Negative.

When the plaster of paris becomes thoroughly set or hard, remove the foot by carefully lifting out the heel and then drawing the foot back and upward. After five or ten minutes this cast is to be lubricated with cold cream, oil or vaseline.

The lubricant is put into the negative cast and on the outer edges around the impression to prevent the counter or positive cast from adhering.

Another batch of plaster should now be mixed and poured into the negative, as illustrated in Chart No. 220, permitting it to work its way around the entire cast, thus preventing air-bells or bubbles. When the plaster becomes heavier add a sufficient quantity to fill the depression, allowing it to set for about twenty minutes, when the negative may be broken and the positive removed.

The best way to remove the positive or positive cast is by taking a hammer as in Chart No. 221 and breaking first the outer side, then the toe part. After this has been done you will find the cast is now entirely free from the shell or negative as in Chart No. 222.

To Take a Plaster Cast of the Entire Foot Above the Ankle.

The previous method of taking a Plantar surface impression should be followed, but the foot is not to be removed. A double layer of tissue paper is evenly placed around the foot over the sole impression, instead of oiling to prevent the adherence of the other wet plaster added above. Now obtain a strong piece of white cord, which is tied around the leg above the ankle, as in Chart No. 223, one end dropped down back over the Tendo-Achillis and the other end forward down the center of and over the Dorsum of the foot to the second toe. The purpose of this string is to cut the upper cast before it is entirely set. Now mix the plaster in the usual manner, somewhat thinner than before, and place it around the foot with your hands, entirely covering it, as in Chart No. 224, being careful that the cord closely adheres to the flesh, and that the plaster is smoothly applied.

To mix the first batch, a pound of plaster to ten ounces, a little over a half pint, of water is sufficient. Allow this to set for a few minutes; in the intervening time mix another batch using about four pounds of plaster, somewhat thinner than usual but heavier than the previous mixture.

Chart No. 223
Cord Tied Around Top and on Front and Back of Foot to Separate Cast.

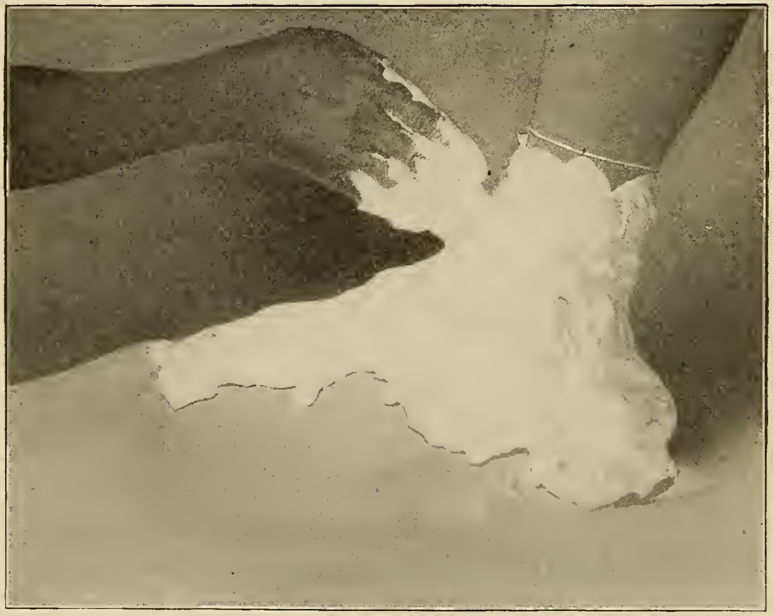


Chart No. 224
Placing Plaster Around Foot Over the Cord.

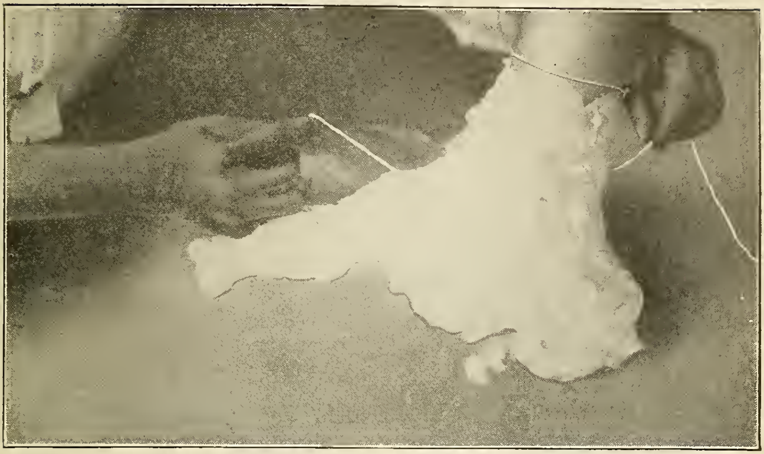


CHART No. 225
Drawing Ends of Cord Through the Plaster.

CHART No. 226
Showing How Flesh is Drawn Away from Cast.

Chart No. 227
Separating the Two Halves.

Chart No. 228
Casts of Sole and Two Sides Removed from Foot Ready for Lubricating.

Apply this over the now forming shell until a firm and heavy coating is obtained, as in Chart No. 224. When the plaster starts to set take both cords in your hands and draw them up, cutting through

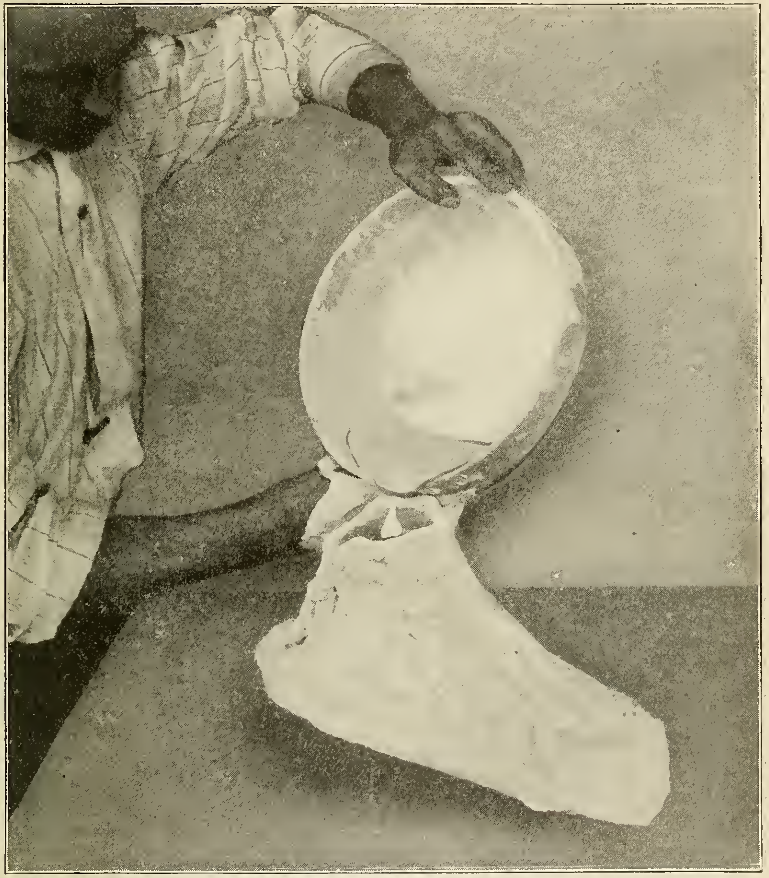


Chart No. 229
Pouring Plaster in Negative After Being Tied Together.

the plaster as you would cut a bar of soap. Now remove the cord, as in Chart No. 225, and allow the plaster to set until it becomes hard.

Do not remove the cord before the plaster starts to set, as it will wash together; also do not let it set too hard, as you will be unable to remove it, and consequently will have to break the shell in order to remove it from the foot.

To free the hair from the cast before it becomes entirely hard, grasp the leg as in Chart No. 226 and draw the flesh away from the

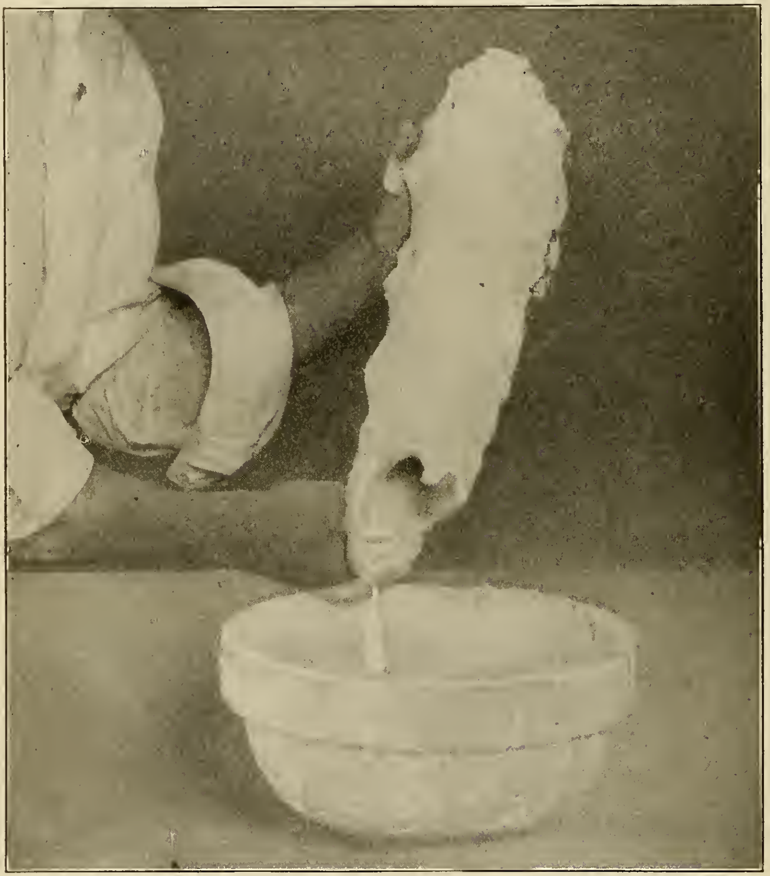


Chart No. 230
Pouring Plaster Back Into Bowl.

cast. Generally it requires about six or seven minutes for the plaster to set, but this varies according to climatic conditions and to the nature of your preparation.

It can be seen in Chart No. 227 how two halves can be readily freed by gently prying in the front and back with a screwdriver.

Chart No. 228 shows three parts of the cast all ready for lubricating, which may be plastered or tied together with cord.

As you now have a complete negative cast of the foot, and are ready for the positive or counter cast, prepare your mixture, which is to have the consistency of cream; then place your cast at an angle,

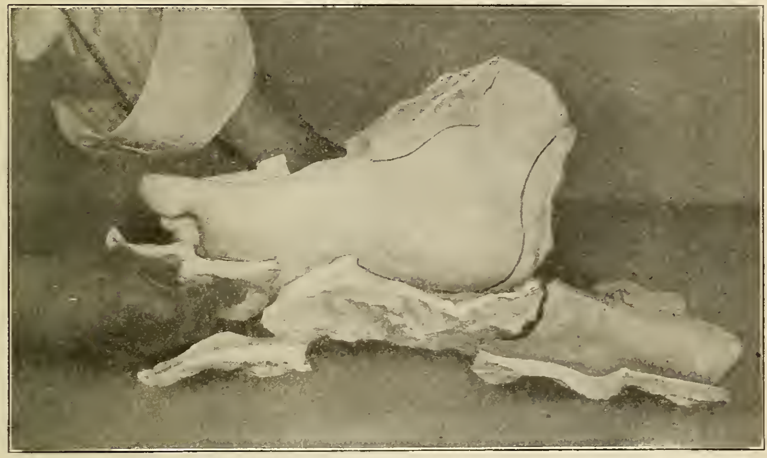


Chart No. 231
Shell is Broken and Cast is Removed.

as in Chart No. 229, in order that the plaster will flow evenly into all points of the cast. You then fill the cast about half full, rotating it to wash the plaster, avoiding air-bells or bubbles; it is then poured back into the bowl as in Chart No. 230

This operation should be repeated two or three times until an inner coat, three-fourths to an inch in thickness, is formed on the entire inner side of the shell or negative, and in which time will become quite hard and unable to run.

By following these directions a firm, strong cast, light in weight, can be made. It requires about thirty-six hours to thoroughly dry out.

CHART No. 232
Finished Cast and Original Foot.

If a solid cast is desired the same method should be pursued, finally filling the entire shell.

This is set aside for twenty minutes to a half hour and the shell then broken and removed as shown in Chart No. 231.

Chart No. 233
Plaster is Poured into Towel or Paper Placed in Palm of Hand.

Chart No. 234
Placed About Part to be Taken.

If these directions are adhered to and the work carefully performed, the completed cast will be a perfect reproduction of the patient's foot, showing in detail every line of demarkation and deformities as found in the natural foot. (See Chart No. 232.)

Chart No. 235
Removing Hand, Towel or Paper.

Chart No. 236
Negative Removed Ready for Counter Cast.

Method of Taking Cast of Bunion or Enlarged Toe Joint.

The surface of the foot about the bunion is lubricated as previously described. Having the mixture prepared, a double layer of towels or newspapers is placed in the palm of the hand as in Chart No. 233,

Chart No. 237
Removing the Cast from Negative Showing Exact Reproduction of Enlarged Toe Joint.

then placed directly over and around the part from which the cast is to be taken. (See Chart No. 234.)

Allow to set for about eight to ten minutes, when the towel should be removed as in Chart No. 235, then gently loosen and remove the negative from the foot. (See Chart No. 236.) Permit this to set for thirty minutes, lubricate inside and around the top edge, then prepare the mixture and pour it into the negative cast, allowing it to set for fifteen minutes when it may be removed. (See Chart No. 237.)

These casts are necessary and convenient when a special bunion reducer is to be fitted; also when the reducer or shield is to be made to the order of the patient.

Index to Illustrations

Index to Subjects

A

B

C

D

E

F

G

H

I

J

K

L

N

O

P

R

S

T

W

Y